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REPORT OF
JOINT BOARD ON
METROPOLITAN IMPROVEMENTS
COMMISSION

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The Commonwealth of Massachusetts.

FINAL REPORT

OF THE

**JOINT BOARD ON METROPOLITAN
IMPROVEMENTS,**

**PURSUANT TO CHAPTER 113 OF THE RESOLVES OF 1909
AND CHAPTERS 112 AND 134 OF THE
RESOLVES OF 1910.**



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CONTENTS.

	PAGE
Legislation,	7
Report of the Board: —	
Scope of Work of the Board,	12
Subjects considered,	15
Harbor Front and Terminals,	15
Harbor Improvements in Dorchester Bay,	15
Atlantic Avenue Front,	16
Westerly Shore of East Boston,	17
Easterly Shore of East Boston,	17
Commonwealth Flats at South Boston,	19
Relative to the Construction of a Dry Dock by the Commonwealth,	23
Civic Improvements and Highways,	25
Civic Centers,	25
The Charles River Basin,	26
Highway Improvements,	29
Old Colony Boulevard-Highway,	29
Cambridge-Somerville Boulevard-Highway,	30
Certain Streets in Boston,	34
Arlington Street Extension,	35
Highway Approach to Charles River Dam,	36
Pleasant Street Improvement,	36
New Highway between North and South Stations,	37
A Systematic Method of Internal Communication by Highways,	38
A Tunnel between the North and South Stations,	39
Excess Condemnation of Land as affecting Highway and Tunnel Question,	42
Electrification of Steam Railroads,	46
Act to provide for Electrification,	78
Appendices: —	
Preliminary Report of Joint Board,	85
Island in Charles River (Report of Robert P. Bellows),	95
Draft of Act to provide for Report upon Further Development of Charles River Basin,	104
Draft of Old Colony Boulevard-Highway Act,	105
Draft of Cambridge-Somerville Boulevard-Highway Act,	107
Highway Connection between Causeway Street and Charles River Dam (Report of Arthur A. Shurtleff),	108
Cost of Highway between the North and South Stations (Report of Leslie C. Wead),	110
Draft of Act to provide for a System of Metropolitan Highways,	114
Draft of Act to provide for the Construction of a Tunnel between the North and South Stations,	115
Report of the New York, New Haven & Hartford Railroad on Electrification,	121
Report of the Boston & Maine Railroad on Electrification,	121
Report of the Boston & Albany Railroad on Electrification,	131
Report of the Boston, Revere Beach & Lynn Railroad ———— tion,	138

<i>Appendices — Concluded.</i>		PAGE
Value of Exports and Imports at Boston for a Series of Years,		141
Value of Exports and Imports at Principal Ports of the United States for a Series of Years,		142
Registered Tonnage of Vessels entered and cleared at Principal Ports of the United States for a Series of Years,		144

LIST OF MAPS, PLANS AND DIAGRAMS.

Plan showing Possible Improvement of East Boston Flats,	18
Plan of Old Colony Boulevard-Highway,	30
Plan of Cambridge-Somerville Boulevard-Highway,	32
Sketches of an Island in Charles River,	98
Studies for a Road Connection between Lowell Street and Charles River Dam,	108
Plan of a New Highway between North and South Stations, by Leslie C. Woad,	112
Map of Boston & Maine Railroad and New York, New Haven & Hartford Railroad in Boston and Vicinity,	130
Map of New York, New Haven & Hartford Railroad, showing Proposed Boston Electrification Zone,	130
Diagram showing Trains in and out of North and South Stations,	130
Diagram showing Curves of Train Weights, New York, New Haven & Hartford Railroad,	130
Diagram showing Curves of Train Weights, Boston & Maine Railroad, . .	130
Diagram showing Combined Totals of Curves of Train Weights for New York, New Haven & Hartford and Boston & Maine Railroads,	130
Diagram showing Combined Totals of Curves of Moving Train Weights and Power required, New York, New Haven & Hartford and Boston & Maine Systems,	130
Map showing Electrification System of Boston & Albany Railroad,	136
Diagram of Train and Power Station Load, Boston & Albany Railroad, . .	136
Diagram showing Schedule of Boston & Albany Railroad possible with Electrification,	136

LEGISLATION.

CHAPTER 108, RESOLVES OF 1907.

RESOLVE TO PROVIDE FOR THE APPOINTMENT OF A COMMISSION TO INVESTIGATE THE SUBJECT OF PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Resolved, That the governor, by and with the advice and consent of the council, shall appoint three persons, and the mayor of the city of Boston shall appoint two persons, who shall together constitute a commission of five for the purposes hereinafter named. The chairman of said commission shall be designated by the governor. The said appointees shall serve without compensation, and shall be persons of recognized qualifications and large experience in respect to one or more of the following subjects or professions, namely: finance, commerce, industry, transportation, real estate, architecture, engineering, civic administration and law. Said commission shall investigate and report as to the advisability of any public works in the metropolitan district which in its opinion will tend to the convenience of the people, the development of local business, the beautifying of the district, or the improvement of the same as a place of residence. It shall consider the establishment of a systematic method of internal communication by highways, the control or direction of traffic and transportation, and the location of such docks and terminals as the interests of the district may demand. It shall recommend the method of executing and paying for such improvements as it may suggest, and shall make such maps, plans and estimates of cost as may be needed for its investigation, or for the proper presentation of its conclusions, and may employ such assistants therefor as it deems necessary. The commission may expend such sums of money, not exceeding twenty-five thousand dollars, for clerical, expert and other assistance, and for other incidental expenses, as it deems necessary. The commission shall make its final report to the governor and to the mayor of Boston on or before the first day of December, nineteen hundred and eight, and its powers and duties shall then terminate. The governor shall transmit the report to the general court of the year nineteen hundred and nine. The expenses incurred under the provisions of this act shall be assessed upon the metropolitan parks district. [Approved June 15, 1907.]

CHAPTER 143. RESOLVES OF 1908.

RESOLVE RELATIVE TO THE COMMISSION APPOINTED TO INVESTIGATE THE SUBJECT OF PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Revised. That the time at which the commission to investigate the subject of public improvements for the metropolitan district, appointed under chapter one hundred and eight of the resolves of the year nineteen hundred and seven, was required to report by the said chapter is hereby extended until the fifteenth day of March in the year nineteen hundred and nine; and the commission may expend for the purposes stated in said chapter an additional sum not exceeding ten thousand dollars. The expenses incurred under this resolve shall be assessed upon the metropolitan park district. [Approved June 13, 1908.]

CHAPTER 113. RESOLVES OF 1909.

RESOLVE TO PROVIDE FOR AN INVESTIGATION AND REPORT RELATIVE TO PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Revised. That the members of the board of railroad commissioners, the board of harbor and land commissioners, the Boston transit commission and the metropolitan park commission are hereby instructed to sit together as a joint board for the purposes specified in chapter one hundred and eight of the resolves of the year nineteen hundred and seven, and the report transmitted to the general court under the terms of said resolve is referred to said joint board for its consideration. The members of the joint board shall serve without compensation other than their official salaries, but the joint board may expend such sums of money as may be approved by the governor and council, and the expenses so incurred shall be assessed upon the metropolitan parks district. Reports may be made by the joint board to the general court from time to time. A preliminary report shall be made to the general court on or before the first day of January, nineteen hundred and ten, informing the general court whether or not any immediate action by it is necessary or desirable, and if any action or legislation is recommended, a bill or bills shall be submitted embodying such recommendations. A final report shall be made by the joint board to the general court on or before the first day of January, nineteen hundred and eleven, said report to be accompanied by a bill or bills embodying any further recommendations which may be made. [Approved May 28, 1909.]

CHAPTER 521. ACTS OF 1909.

AN ACT MAKING AN APPROPRIATION FOR AN INVESTIGATION AND REPORT RELATIVE TO PUBLIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Be it enacted, etc., as follows:

SECTION 1. The sum of ten thousand dollars is hereby appropriated to be paid out of the Metropolitan Parks Maintenance Fund, for th

purpose of meeting the expenses of an investigation and report relative to public improvements for the metropolitan district by the board of railroad commissioners, the board of harbor and land commissioners, the Boston transit commission, and the metropolitan park commission, sitting as a joint board, as provided by chapter one hundred and thirteen of the resolves of the present year.

SECTION 2. This act shall take effect upon its passage. [*Approved June 18, 1909.*]

CHAPTER 112, RESOLVES OF 1910.

RESOLVE TO PROVIDE FOR AN INVESTIGATION RELATIVE TO THE CONSTRUCTION OF A TUNNEL BETWEEN THE NORTH AND SOUTH STATIONS IN THE CITY OF BOSTON.

Resolved, That the board of railroad commissioners, the board of harbor and land commissioners, the Boston transit commission and the metropolitan park commission, sitting together as a joint board under the provisions of chapter one hundred and thirteen of the resolves of the year nineteen hundred and nine, are hereby directed to hold public hearings on the advisability of constructing a tunnel between the North and South stations in the city of Boston; on the question whether such a tunnel should be built and owned by the commonwealth, by the city of Boston, by a railroad company or companies, or by some holding or terminal company; on the terms upon which said tunnel should be constructed; and, in case the tunnel should not be constructed by the commonwealth or by the city of Boston, on the terms upon which the tunnel might be acquired either by the commonwealth or by the city. Said joint board shall report its conclusions in print to the next general court on the first Wednesday of January, nineteen hundred and eleven, especially giving its reasons for recommending either public or private ownership of the tunnel; and the board is also directed to report at the same time a bill providing for the construction of the said tunnel and fixing the route therefor, or, if it is impossible to determine a route at the time aforesaid, to provide in the bill that the determination of the location of the tunnel shall be left to some public board or boards. [*Approved June 1, 1910.*]

CHAPTER 134, RESOLVES OF 1910.

RESOLVE RELATIVE TO THE ELECTRIFICATION OF RAILROADS IN THE METROPOLITAN DISTRICT.

Resolved, That the railroad corporations operating within the metropolitan district of Boston be directed to prosecute studies with reference to the electrification of their passenger service in said district, and to present the results of such studies on or before the first day of next November to the joint board on metropolitan improvements, created by chapter one hundred and thirteen of the resolves of the year nineteen hundred and nine; and that the said joint board be directed to continue its investigation of this subject and to make report thereon in print to

the general court on or before the fifteenth day of January, nineteen hundred and eleven, with the draft of an act which shall provide for the electrification of all railroads of standard gauge in the metropolitan district within a stated time, and which shall empower the proper board or boards to determine the manner in which the work shall be prosecuted. [*Approved June 10, 1910.*]

CHAPTER 618, ACTS OF 1910.

AN ACT IN FURTHER ADDITION TO AN ACT MAKING APPROPRIATIONS FOR SUNDRY MISCELLANEOUS EXPENSES AUTHORIZED DURING THE PRESENT YEAR, AND FOR CERTAIN OTHER EXPENSES AUTHORIZED BY LAW.

Be it enacted, etc., as follows:

SECTION 1. The sums hereinafter mentioned are appropriated, to be paid out of the treasury of the commonwealth from the ordinary revenue, except as hereinafter provided, for the purposes specified, to wit:—

To provide for an investigation relative to the construction of a tunnel between the North and South stations in the city of Boston, as authorized by chapter one hundred and twelve of the resolves of the present year, a sum not exceeding five thousand dollars.

SECTION 2. This act shall take effect upon its passage. [*Approved June 14, 1910.*]

The following acts and resolves also have a bearing upon the work of the Board:—

Resolve of 1910, being a "Resolve providing for an amendment of the constitution increasing the power of the Legislature to authorize the taking of land and property for highways or streets."

Statutes 1910, chapter 331, being "An Act to approve the acquisition by the United States of a tract of land in the city of Boston."

Statutes 1910, chapter 586, being "An Act to provide further for the improvement of the Commonwealth's flats at South Boston."

Statutes 1910, chapter 623, being "An Act to change the harbor line in Boston harbor at Jeffries Point."

Statutes 1910, chapter 646, being "An Act to authorize the Massachusetts highway commission to make certain purchases and takings of land in the town of Revere."

Statutes 1910, chapter 648, being "An Act to provide further for the development of the Commonwealth's flats at East Boston."

Resolves 1910, chapters 58, 64, 67 and 130, being resolves providing for an investigation and report by a Joint Board, consisting of the Board of Railroad Commissioners and the Boston Transit Commission in relation to the construction and use of subways and tunnels and c

tain other matters affecting street railways in the city of Boston and vicinity.

Resolves 1910, chapter 98, being a "Resolve directing the metropolitan park commission to investigate the advisability and cost of a parkway between West Roxbury in the city of Boston and the town of Watertown."

Resolves 1910, chapter 130, being a "Resolve to provide for a report by the metropolitan park commission as to the cost and advisability of completing the metropolitan boulevard in the city of Quincy."

Resolves 1910, chapter 132, being a "Resolve to provide for a report [by the Board of Railroad Commissioners] as to the advisability of authorizing the Old Colony Railroad Company to construct a connection of its railroad between Mattapan and Clarendon Hills."

REPORT.

To the Honorable the Senate and the House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The members of the Board of Railroad Commissioners, the Board of Harbor and Light Commissioners, the Boston Transit Commission, and the Metropolitan Park Commission, sitting together as a Joint Board, under the provisions of chapter 113 of the Resolves of the General Court for the year 1909, present a final report, as follows:—

Duly advertised public hearings have been held, and all persons who have duly given notice of a desire for a hearing have been fully heard.

The scope of the work of this Board is by reference set forth in chapter 194 of the Resolves of the year 1907, as follows:—

First, to investigate and report as to the advisability of any public works in the Metropolitan District which in its opinion will tend to the convenience of the people, the development of local business, the beautifying of the district, or the improvement of the same as a place of residence.

Second, to consider the establishment of a systematic method of internal communication by highways.

Third, to consider the control or direction of traffic and transportation.

Fourth, to consider the location of such docks and terminals as the interests of the district may demand.

Fifth, to recommend the method of executing and paying for such improvements as it may suggest, and to make such plans and estimates of cost as may be needed for its investigation or for the proper presentation of its conclusions.

In the report of the Commission on Metropolitan Improvements, submitted to the Legislature in 1909, and which was, by the act creating this Joint Board, referred to it for consideration, these several matters have received a comp

and most valuable discussion, combined with experts' reports, full of instruction as to experience in this country and in Europe and of suggestions as to what are Boston's possibilities.

This Board understands that it was the intention of the Legislature that it should supplement the work of the Metropolitan Improvements Commission by selecting and advancing such of its suggestions and adding such others as seemed to call most strongly for immediate and definite action.

Some of these matters were touched upon in the preliminary report made to the Legislature under date of Jan. 1, 1910 (Senate Document, No. 27. Appendix, page 85).

The first suggestion in that report related to the East Boston flats. In furtherance of such suggestion, the Legislature passed Statutes 1910, chapter 623, being "An Act to change the harbor line in Boston harbor at Jeffries point;" and Statutes 1910, chapter 648, being "An Act to provide further for the development of the Commonwealth's flats at East Boston." Reference is also made to Statutes 1910, chapter 331, being "An Act to approve the acquisition by the United States of a tract of land in the city of Boston."

The next suggestion in the preliminary report of this Board, related to the Commonwealth's flats at South Boston. In furtherance of that suggestion, the Legislature passed Statutes 1910, chapter 586, being "An Act to provide further for the improvement of the Commonwealth's flats at South Boston."

The third matter in said preliminary report related to railroad service and the bearing of electrification on plans for its improvement. In furtherance of that suggestion, Resolves 1910, chapter 134, being a "Resolve relative to the electrification of railroads in the metropolitan district," was passed.

The fourth suggestion related to a new business thoroughfare and a railroad tunnel under it, connecting The New York, New Haven & Hartford and the Boston & Maine systems; and thereunder attention was called to the extent of the power of the Legislature under the Constitution to authorize takings of land along the route of a proposed highway, when needed to provide building sites sufficient for the construction of buildings of size and character appropriate to the importance of the highway. Pursuant to this suggestion, the opinion of the

justices of the Supreme Judicial Court was required by the Legislature as to its power to authorize such takings. The justices having answered that the Legislature did not possess such power, a resolve providing for an amendment to the Constitution, increasing the power of the Legislature to authorize takings of land and property in connection with the laying out of highways or streets, was agreed to by both branches of the Legislature, and, as provided in the Constitution, was referred to the next General Court.

The last matter treated in the preliminary report related to highway and parkway improvements, with a special recommendation in regard to a traffic road between Revere Street and Lynnway in the town of Revere. This recommendation was followed by the enactment of Statutes 1910, chapter 646, being "An Act to authorize the Massachusetts highway commission to make certain purchases and takings of land in the town of Revere."

By Resolves 1910, chapter 112, this Joint Board was specifically instructed to make an investigation relative to the construction of a tunnel between the North and South stations in the city of Boston; and by Resolves 1910, chapter 134, the railroad corporations were directed to report on or before the first of November last to this Board with reference to electrification of their passenger service in the District, and this Board was specially directed to continue its investigation and make report thereon.

On the other hand, this Joint Board has been definitely relieved from the consideration of various matters which might have been regarded as within the scope of its work. By Resolves 1910, chapters 58, 94, 97 and 130, the duty of conducting investigations in relation to the construction and use of subways and tunnels and certain other matters affecting the street railways in the city of Boston and vicinity was referred to a Joint Board consisting of the Board of Railroad Commissioners and the Boston Transit Commission. By Resolves 1910, chapter 98, the Metropolitan Park Commission was instructed to investigate the advisability and cost of a parkway between West Roxbury in the city of Boston and the town of Watertown. By Resolves 1910, chapter 130, the Metropolitan Park C

was instructed to report as to the cost and advisability of completing the Metropolitan boulevard in the city of Quincy; and by Resolves 1910, chapter 132, the Board of Railroad Commissioners was instructed to report as to the advisability of authorizing the Old Colony Railroad to construct a railroad between Mattapan and Clarendon Hills.

In making this report, this Board treats of various matters which seem to it to call for present action, under the following heads: —

1. Harbor front and terminals.
2. Civic improvements and highways.
3. A tunnel between the North and South stations, with or without a highway over it.
4. Electrification.

HARBOR FRONT AND TERMINALS.

I. HARBOR IMPROVEMENTS IN DORCHESTER BAY.

The improvement of the shores of Dorchester Bay is a matter that has been under discussion and investigation by various boards and commissions in recent years, and many plans have been outlined for the development of the foreshore. In the report of the State Board on Docks and Terminal Facilities, made to the Legislature in 1897, a recommendation was made that a small portion of this territory might be taken by the State and reserved for future development; but the authority granted to the Harbor and Land Commission later by legislative act exempted this territory.

The northerly portion of the bay, bounded by the South Boston peninsula, has been dedicated to parkway and similar improvements, the State having expended a large sum of money in dredging anchorage basins for yachts. This cuts off substantially two miles of the shore front. The remaining portion, from the end of the so-called strandway to the Neponset River, is admirably situated for development under private enterprise for manufacturing and smaller wharfage purposes, being contiguous to a large and growing section of the city, which would ~~vide~~ ^{provide} the necessary population to carry on such industries as established in this territory. The ample provision for

docks and wharves for ocean commerce, already outlined in the upper harbor on the East Boston and South Boston sides, would take care of the future commerce of the port without encroaching on this territory; and we therefore believe that the shores of Dorchester Bay should be left as they are at present, in the control of private ownership for development along lines heretofore outlined.

II. ATLANTIC AVENUE FRONT.

The Joint Board has considered the advisability of further increasing the public ownership of wharves and shore in Boston harbor. It has been suggested that the city or State take the property on Atlantic Avenue extending southerly from the South Ferry as far as Rowe's wharf. This would include Lewis wharf, Commercial wharf, Mercantile wharf, T wharf, Long wharf, Central wharf and India wharf. The aggregate length of these several properties on Atlantic Avenue is approximately 2,500 feet, and a little longer on the pierhead line. The depth of water in the several docks varies from 18 to 25 feet at mean low water. From the pierhead line to the main ship channel the depth at mean low water is approximately 23 feet. The average width of this frontage, measuring from Atlantic Avenue to the pierhead line, is about 600 feet, and the several docks vary in length from 350 feet to 825 feet. It is an excellent location for the receipt and discharge of cargoes from coastwise vessels or tramp steamers for local delivery, and for excursion and coastwise passenger steamers. The handling of cargoes could be greatly facilitated and the expense lessened if modern double-deck piers with electric hoists were constructed, in place of the old, ill-shaped wooden structures. These piers could not, however, be provided at reasonable cost with good railroad connections or with a freight yard.

The assessed valuation for the year 1909 of this area, including the land and the old buildings thereon, aggregates \$5,000,000. This large sum would be further increased by added land damages under eminent domain proceedings, the tearing down of buildings, reconstruction of piers and building new sheds and warehouses on the property, adapted to modern methods of receiving and discharging freight and passengers.

This would make the first cost of new piers similar to the Chelsea piers on North River in New York very expensive. The demand and use for them at a rental equivalent to 4 per cent. of the cost would be problematical; therefore, the Board has not felt justified in recommending that this area be taken for public improvement and ownership.

III. WESTERLY SHORE OF EAST BOSTON.

The westerly shore of East Boston presents a fine opportunity for the establishment of manufacturing plants. It is only partly occupied, the Atlantic Works being the largest plant there established. The pierhead line abuts on the 35-foot government channel, and the docks and piers vary in length from about 300 feet to 1,100 feet, without materially changing the present line of the bulkhead.

The one thing lacking for the proper and easy development of this frontage is railroad connection. If the city of Boston would widen abutting streets, and the Boston & Albany Railroad could be induced to construct its road from its bridge across Chelsea Creek westerly to Condor Street and thence along Border Street to connect with its present tracks on Marginal Street, the use of that frontage on Chelsea Creek and the main ship channel would be assured.

This subject was referred to the Joint Board of Railroad Commissioners and Harbor and Land Commissioners, who made a report thereon in the year 1909. The expense would be large, but the opportunity for developing manufacturing plants would be attractive. The Joint Board does not recommend that this be undertaken at public expense.

IV. EASTERLY SHORE OF EAST BOSTON.

The most favorable place for a large development of a water and railroad freight terminal in Boston harbor is the easterly side of East Boston. The Commonwealth has acquired, under the provisions of chapter 486 of the Acts of 1897, an area having a frontage of over 3,000 feet, as shown on plan herewith. It also owns large areas of flats to the north and east of this taking. The areas owned by the State, by the city of Boston

and by the United States aggregate in round numbers about 2,000 acres. They are now useless to any person, but could be developed at reasonable expense into a railroad and steamship terminal, with long piers, large warehouses and ample railroad freight yards.

The plan outlined in 1897 by the State Board on Docks and Terminal Facilities was to build short piers 600 feet long, and connect the same with the Boston & Albany Railroad. Piers of that length would be adapted to coastwise steamers and barges, and supply the reasonable needs of manufacturing plants which may be located on the easterly side of East Boston. A new and larger plan of development has been outlined and considered by the Joint Board.

The harbor line has been changed, as shown on the plan, to accommodate the larger development suitable for the dockage of the largest steamships afloat. (See plan opposite.) If piers are built on the harbor line of 1910, the result will be the closing of a good channel at Jeffries Point, and the necessity of dredging Bird Island flats, part of which have already been dredged for the increase of the anchorage area in Boston harbor. It would also be necessary to increase the depth of the back channel or Governor's Island channel from President Roads to the piers which might be constructed on the harbor line of 1910. The dredging of Bird Island flats and the deepening of this channel would be a very expensive undertaking.

If this project is undertaken, the piers must be connected by highway and railroad with the central part of East Boston.

Chapter 648 of the Acts of 1910 authorizes the construction of highways and the location and filling for railroad connections, also the building of piers whenever any person or corporation desires to lease and use the same.

The Joint Board recommends the development of the East Boston flats as authorized by chapter 648 of the Acts of 1910, as soon as there is evidence of a demand for additional piers and docks.



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V. COMMONWEALTH FLATS AT SOUTH BOSTON.

The constantly increasing size of ocean steamships requires longer piers and better terminal facilities. The report of the Dock Commissioner of the City of New York, published in 1910, emphasizes the difficulties of providing suitable access to the water and railroad terminals of New York. The new Chelsea piers built by the city on North River at about Twenty Third Street accommodate the "Lusitania" class of steamships, the largest now afloat. They were first occupied in the year 1909, and are already inadequate for the new White Star steamships now under construction and intended for the port of New York, and it is stated in the public prints that the Cunard Company is to contract for still larger steamships for its New York service. The Dock Commissioner says that this class of ocean steamships cannot be docked on Manhattan Island, and will probably be obliged in the future to dock at piers yet to be built either in the South Brooklyn or Staten Island districts. He also reports that the demand for more and better pier and terminal facilities along the west side of Manhattan is steadily increasing, and he is constantly in receipt of requests for additional piers.

New York as a port is in a class by itself, yet the increasing congestion of piers and terminals and the difficulty in supplying the demands at this great port carry a suggestion for Boston.

It seems not to be generally known that at South Boston are piers at which not only may the steamships of the "Lusitania" class be berthed, but also those other leviathans of the ocean now approaching completion and to be contracted for.

The longest steamships now entering the port of New York are about 800 feet, and the new Chelsea piers are just 800 feet in length. The largest steamships now proposed by marine architects are about 900 feet, and the Commonwealth pier, just leased to the Old Colony Railroad Company, is 1,200 feet long. This pier and the others of the New Haven road alongside furnish ample accommodation for those largest steamships which cannot now be berthed at the port of New York. The main ship channel passes within about 700 feet of the end of the Commonwealth pier, and the berths at present are 35 feet deep at mean

low water. Although the main ship channel in Boston harbor is only 35 feet deep at mean low water, the range of tide is from $9\frac{1}{2}$ to 12 feet, which makes it therefore equal to the New York ship channel, and the Boston harbor channel is much less congested.

Construction has been commenced on a pier 1,200 feet long next easterly of the Commonwealth pier, for the Boston Fish Market Corporation, which will afford ample accommodation for the development of the fish industry. There remains sufficient room for another large pier next easterly of the fish pier, without interfering with the smaller piers leased and occupied by the coal dealers. Easterly of the Boston Molasses Company's pier there is also an available frontage of more than 5,000 feet along the channel, where other piers from 800 to 1,200 feet long may be constructed as required. On the Reserved Channel from L. Street bridge toward the ship channel is an ideal place for the construction and use of smaller piers 300 to 400 feet in length, with sufficient filled land in the rear to accommodate the users of the piers with freight and storage warehouses.

From Fort Point Channel easterly along the inner ends of the piers and docks runs Northern Avenue, laid out by chapter 381 of the Acts of 1903, 100 feet in width, and to be shortly constructed to the easterly line of Pier No. 6, being built for the Boston Fish Market Corporation. Between Northern Avenue and Summer Street, southwesterly, is a large area of filled flats ready for use and sufficient in area for railroad tracks, freight houses and warehouses, to be used in connection with the business that is or will be conducted at the several piers now built or to be built.

This Joint Board last year prepared a model showing a viaduct extending from Summer Street across to the Commonwealth pier, by means of which passenger and light freight could be discharged on the upper level and cargo on the lower level, which would greatly facilitate the loading and unloading of steamships. This viaduct could be extended on the upper level east and west along Northern Avenue, so that the sheds on the piers might thus be connected with streets and roadways at the upper and the lower level.

The ideal condition as recognized by experts for the construction and operation of water and railroad terminals exists here at South Boston. There is a deep and wide main ship channel entering the upper harbor. About 700 feet westerly is the pier-head line, along which piers 1,200 feet long may be constructed. Then comes Northern Avenue, a wide traffic road on the grade of the piers. Still farther westerly is the large area of land between Northern Avenue and Summer Street, on which railroad tracks may be laid and freight sheds and warehouses be built, and the cars may be run alongside the steamships on the piers or switched into the sheds and warehouses from the outlying freight yards of the New Haven and other railroads; and over this area from Summer Street may be extended the viaduct to Northern Avenue, giving easy access to the second story of the sheds and warehouses on the piers or in the yards.

One of the freight yards of the New Haven Railroad is contiguous to this area, and its tracks may easily and rapidly be extended to any pier now built or hereafter to be built along this water front. Connection will in some way be developed between the Boston & Maine tracks and the New Haven tracks, whereby freight cars from the Boston & Maine tracks on the north and west may be switched to these piers; and there is more than one easy way in which the freight traffic of the Boston & Albany Railroad may be connected and brought to this water terminal. Here may be easily conducted freight cars from all the several lines of railroads entering Boston. The northwesterly portion of this area is distant from Post Office Square *via* Northern Avenue bridge and Oliver Street about 1 mile, and is the most conveniently located of any place in Boston for the delivery of freight by truck to and from ocean steamships.

While the project for developing East Boston is admirably adapted to manufacturing purposes and for freight to be delivered from the car to the steamship for Atlantic transportation, the Commonwealth's property at South Boston is much more conveniently located for the handling of freight which has to be carried away by teams, or for any combination of freight and passenger business.

The possibilities of this district for passenger and freight

business, whether through or local, are believed to be unequalled in the Atlantic coast, and future action in regard to it should be such as to preserve unhampered and undiminished all these possibilities.

This Joint Board in its preliminary report last year approved the policy heretofore pursued of holding these flats and this foreground in public ownership for future demands of commerce at any time. This Joint Board desires again to emphasize its opinion that the Commonwealth should continue to own and develop this area for the general public advantages of commerce and navigation. This view coincides with the special report of the State Board of Docks and Terminal Facilities in 1897, and of the Harbor and Land Commissioners' report of 1907.

Between this terminal area above described, the Commonwealth owns on the northeasterly side of Summer Street an area of about 42 acres, on which streets are plotted, and abutting at E. Street on the Reserved Channel. This area is peculiarly adapted for improvement for manufacturing and warehouse purposes.

Under the provisions of law applicable thereto, chapter 377 of the Acts of 1902, railroad tracks can be laid to every factory, warehouse or structure built on this land. It is within 3,000 feet of the Edison Electric Illuminating Company's plant on the southerly side of the Reserved Channel, from which electricity for heating, lighting and power can be delivered at a reasonable price, without the expense of building a large electric plant.

The Reserved Channel is 400 feet wide, and terminates at E. Street on one side of this 43 acres, and has a depth of 12 feet at mean low water, which might readily be increased, if necessary to any desired depth. Lumber, coal and all heavy freights could be delivered to manufacturing plants located thereon. It might cheaply and easily be developed on similar lines to the celebrated Bush Terminal in New York. This land is also well adapted for manufacturing, because plants here located could be easily reached by operatives from South Boston and the southerly suburbs. The product here manufactured could be loaded on steamships at the terminal above described,

loaded into cars and switched to the tracks of any railroad going out of Boston.

These 43 acres may be sold as a whole, or in small parcels suited to the demands of each manufacturer. Three large woolen warehouses have already been built on the southeasterly side of Summer Street, and others are contemplated.

From this area it is an easy haul to all parts of the old business districts of the city, both retail and wholesale.

VI. RELATIVE TO A DRY DOCK TO BE BUILT BY THE COMMONWEALTH IN BOSTON HARBOR.

The twenty-sixth annual report of the Board of Harbor and Land Commissioners for the year 1904 contains a most instructive report on this subject. The only thing that has occurred to change conditions at the port of Boston since that report was made is the completion of the large dry dock at the Navy Yard.

There seems to be a very popular but erroneous idea that the principal business of a dry dock is in connection with repairing vessels injured below the water line. As a matter of fact, this is only an incidental use of a dry dock; its principal business is the annual docking to clean and paint the lower body of vessels, and this cleaning and painting is almost invariably done at the home port of the vessel. All transatlantic vessels coming into Boston are owned in Europe, and are naturally cleaned and painted at their home ports. Present dry-dock facilities at Boston are ample for local and coastwise vessels. The report of the Harbor and Land Commissioners previously referred to sums up the subject as follows (page 98):—

The business of a large dry dock would be very limited in Boston, and practically it would only be called upon to dock vessels over 450 feet long that had met with some accident which rendered an inspection or examination below the water line absolutely necessary; and then in all probability it would be used simply for making such examination and temporary repairs as would enable the ship to reach some other port, where permanent repairs could be made at less cost.

There is no demand from owners of vessels entering the port of Boston for additional dry-dock facilities.

In 1903, 37 different ships more than 450 feet long entered this port, and in 1904 only 22; since then the average for the six years, 1905-10, both inclusive, is about 25 ships more than 450 feet long.

In 1904, when the Board of Harbor and Land Commissioners was investigating the subject, the owners and agents of vessels making this port, in reply to inquiries by the Board, announced that they would not use any dry dock here except in case of an accident to the hull below the water line, and in such case only for necessary temporary repairs. Without exception, the agents and owners answered that they would dock their vessels for painting, cleaning and ordinary repairs at the home port.

Additional facilities would not increase the business of the port of Boston one dollar, so far as we can learn, nor would they decrease insurance rates on either ships or cargoes. There is at the Navy Yard a dry dock 750 feet long, that is available to merchant ships when not otherwise in use. Simpson's dry dock, 450 feet long, is also available when not otherwise in use.

All persons who have urged that the Commonwealth should build, own and operate a dry dock at the port of Boston have had in mind a dry dock large enough to take the largest vessels afloat. That would call for a dry dock over 900 feet long. As a practical question, there are no vessels over 450 feet long seeking dry-dock facilities at the port of Boston.

A graving dock 900 feet long would cost, exclusive of land, not less than \$2,500,000. Its operating cost and up-keep would be about \$40,000 a year; interest at 3½ per cent. and sinking fund charges, \$137,500 a year more, — a total annual charge of about \$177,500, with practically no income to offset this large annual outlay.

A prominent member of the Boston Chamber of Commerce, who advocated in 1904 the building by the Commonwealth of a dry dock in Boston, likened it to "an emergency hospital." In the eight years beginning with 1903, this Joint Board has been unable to learn of any accident which happened to ships entering this port which could not be docked in Simpson's dry docks. That fact demonstrates to the Joint Board that the emergency is not so frequent as to demand a large expenditure by the Commonwealth, especially in view of the fact that the Navy Y^e

dry dock could now be used on such occasions, if not actually occupied by United States vessels.

In view of these facts, the Commonwealth of Massachusetts would not be warranted in constructing, owning and operating a dry dock for the use of docking merchant ships; to do so would be a waste of the public funds to satisfy a mistaken sentiment.

CIVIC IMPROVEMENTS AND HIGHWAYS.

In the matter of civic improvements, and especially of highways, careful attention has been given to the suggestions of the report of the Metropolitan Improvements Commission and its accompanying reports, and also to those in other documents and reports. Public hearings have been held; and facts then presented, together with such as have been otherwise suggested, have also received careful consideration. Expert assistance has been employed, when deemed advisable, for preparing plans and estimates and special reports which are transmitted herewith.

I. CIVIC CENTERS.

The report of the Metropolitan Improvements Commission was accompanied by an article by Robert S. Peabody and Arthur A. Shurtleff, in which the desirability of establishing civic centers for Boston was discussed, and suggestions made as to suitable locations. On page 263 it was said, in regard to one of these locations:—

Castle Square has been suggested as a central site for a civic center, and the undeveloped region between it and Columbus Avenue offers a fine chance for extending and widening Arlington Street in a very monumental way to this site.

This was in line with similar suggestions and sketches submitted by the Committee on Municipal Improvements of the Boston Society of Architects in their 1907 report, at page 16, and is referred to here as a type of all such suggestions.

Upon consideration of this suggestion, and the general aspect of the whole matter, the Joint Board is of the opinion that the establishment of a civic center for any of the several municipalities of the District and the making of changes in streets

for that purpose, whether accompanied by the erection of buildings or not, is a matter of municipal rather than of metropolitan concern, and therefore that in this case it is the business of the city of Boston to determine whether or not it desires to establish a civic center, and whether or not it wishes to develop Castle Square or any other locality for that purpose; and, further, that the indirect interest which the Metropolitan District may have in a development which is so largely a matter of municipal convenience or embellishment does not warrant metropolitan control or contribution.

II. THE CHARLES RIVER BASIN.

The magnificent park of land and water, created by Craigie Dam and the embankment, was so far completed that it was transferred by the Basin Commission which constructed it to the Metropolitan Park Commission on July 1, 1910, and was then opened to public use. It immediately became the court of honor of the Metropolitan District and parks. In the intervening months since the opening of this park the public has become aware of the wonderful improvement already accomplished, and of certain limitations in the fulness of the improvement due to natural caution in the legislation which authorized it and in the plans which were prepared for the great work. The Metropolitan Park Commission will undoubtedly make suggestions and prepare plans for further development and for meeting public convenience with all reasonable speed; but as certain improvements, which were suggested or referred to in the report of the Metropolitan Improvements Commission and previously in the report of the Boston Society of Architects, seem to be worthy of immediate consideration, the Joint Board ventures to refer to them and offer suggestions in regard to them.

The first suggestion is the obvious one of a better approach to the driveway along the easterly side of the embankment and the basin. That driveway, forming a junction with Charles Street and Cambridge Bridge at its northerly end, extends to Back Street, which is the street in the rear of the row of houses fronting on Beacon Street, and there connects on a curve with Otter Street. Otter Street is a narrow way only the length of

a single house lot, which opens into Beacon Street at a point a few houses west of Arlington Street; it is inadequate, obscure and indirect as an approach to the driveway and connection with the principal streets of the city. It seems to the Joint Board that a better way ought to be provided in better alignment with the driveway and Arlington Street to give direct and dignified approach, with views of the embankment and of the Common and Public Garden, not only from Beacon Street and Boylston Street, which are the finest radial highways of the city, but also from Commonwealth Avenue, which is the only parkway from the center of the city to the Boston Park System and the Metropolitan Park System west and south of Boston. Such a connection would seem to find a precedent in park approaches provided for other parks and reservations of the Metropolitan Park System, and to fall logically within the lines of metropolitan work and expenditures already entered into.

The second suggestion is, that there is need of some further development to provide means of utilizing the opportunities for recreation and enjoyment which the basin and embankment present.

The basin is at present a wind-swept lake of magnificent distances, surrounded by a formal embankment so narrow that abutters object to its being occupied by boat houses or other facilities for recreation. The inadequacy of means for utilizing the opportunities for recreation and enjoyment which both basin and embankment present was discussed and suggestions as to means of providing the necessary development suggested, in the report of the Committee on Municipal Improvements of the Boston Society of Architects in 1907, and also in the subsequent report of the Metropolitan Improvements Commission, which has been referred to this Joint Board. Both urged that an expanse of water as great as the basin in the midst of a city population is unnecessary, and that better uses for some portion of it ought to be sought. To this end they suggested that an island be constructed in it, of a formality in harmony with that of the construction already made; and argued that it would break the sweep of the wind and provide locations for boat houses and for other conveniences for sport and recreation, and,

if desired, for notable buildings and dwellings, and leave on the sides streams wider than the Thames in London or the Seine in Paris. Plans illustrating the suggestions of different architects for such an island were submitted with these reports. After these reports were made, a suggestion for an island as a means of providing for facilities for sport and recreation alone was made to the Metropolitan Improvements League of Boston, in connection with suggestions for an economical method of reconstructing Harvard Bridge, by Messrs. Bellows & Gray, architects. While examining these plans, suggestion was made that the cost of such an island might be materially reduced, if the work were undertaken in the near future, by use of material from the subways being constructed or about to be constructed in the city of Boston; and that, if it were deemed wise to construct the island of a size adequate to provide more space than that required for recreation and sport, it might be possible to sell a portion of it at a price sufficient to pay for its cost to some such institution as the Institute of Technology, which was known to be seeking a new location, and otherwise would have to occupy taxable land wherever it might locate. Plans and a report covering these last suggestions, prepared at the request of this Board, are submitted with this report. (Appendix, page 95.)

While this Joint Board is not prepared to approve these suggestions in detail, yet it believes that there is merit enough in them to warrant it in recommending further investigation of details, in the expectation that some modification of the suggestions and plans may furnish a plan by which a central location for the much-needed recreation buildings may be secured at low cost, without interfering with the vistas from the embankment or destroying the beauty or usefulness of the basin.

It is therefore recommended that the matter be referred to the Metropolitan Park Commission, with authority and instruction to that Board to investigate and report, with plans and estimates on or before Dec. 11, 1911, both for an approach to Charles River embankment from Arlington Street, and for an island or some other form of development and utilization of the basin, and opportunities for recreation and sport; and a bill is submitted to that effect. (Appendix, page 104.)

III. HIGHWAY IMPROVEMENTS.

The Joint Board is of the opinion that it is wise at this time to make specific report in regard to certain highways and other improvements only, which would be extensions of metropolitan works already entered upon or intimately connected with such works, because these seem likely to serve an immediate usefulness of great value, and because they may apparently be provided for more economically now than at any future time. Facts and figures are presented as to these, and bills providing for their execution and the method of paying for them, and the opinion is recorded that, while the expense involved may seem heavy, the improvements are ones which the Metropolitan District cannot afford to postpone.

1. *Old Colony Boulevard-Highway.*

From the South Station in Boston a highway extends to Columbia Road over a part of Dorchester Avenue and over the old location of the New York, New Haven & Hartford Railroad, which, with slight improvement by the city, may be made the beginning of one of the best radial highways out of Boston. At Columbia Road this highway now comes to an abrupt ending. Beyond Columbia Road on the easterly side of the railroad are large tracts of unoccupied land and intervening residential sections of Savin Hill, Harrison Square and Neponset, all in Boston; and beyond Neponset Bridge the land is open, with the exception of a few dwellings and other buildings of moderate value, to the point where the Metropolitan Parkway to Quincy Shore begins. So much of this region as lies east of the railroad in Boston has no direct highway and electric car connection with the central part of Boston, and only inconvenient and indirect approach by the main already overcrowded highways west of the railroad. It needs only an excellent highway and electric railway line on the east of the railroad to make these open lands available and excellent locations for dwellings, large manufacturing and incidental commercial enterprises. Furthermore, on the entire south side of Boston there is no good road which furnishes direct line for rapidly moving vehicles all the way from the business center of Boston to southern

parts of the District and State except the Fenway, which is indirect and on the extreme westerly side of the city.

The opportunity is still open to make direct highway communication from the business part of the city with the unoccupied lands and the residential section beyond Columbia Road and east of the railroad, and at the same time to provide a roadway for rapidly moving vehicles to this portion of the city and to all southern portions of the District and of the State beyond Neponset Bridge. If the land is acquired according to some such plan as that submitted herewith (See plan opposite), few buildings will have to be removed, the total assessed value of the real estate required will be less than \$400,000, and present facilities for railroad and harbor communication will be preserved for the remaining land, as clearly they ought to be preserved upon any plan which may be adopted. It is a fortunate and remarkable opportunity, which, if not now availed of, may soon be lost forever. Construction, estimated for both roadways to cost approximately \$800,000, may wait; but delay in securing the necessary land will be most unfortunate.

In connection with this project consideration has been given to the possibility of a reduction in its net cost by excess land acquirements in case the constitutional amendment to that effect should be adopted. It appears that there is possibility of such reduction in the case of this project if additional vacant land should also be acquired and brought under one ownership, re-lotted on a comprehensive plan suitable for industrial and commercial uses, and then sold at the natural increase in prices which would result from the improvement.

2. Cambridge-Somerville Boulevard-Highway.

This project has been favorably reported upon several times in one form or another by other boards. It is the most needed and desired highway improvement in eastern Massachusetts, and would be a gateway to all northern portions of the Commonwealth and to the northern portions of the Metropolitan Park System. The Metropolitan Park District has a population of over 1,400,000. More than 600,000 of this population live north of Charles River, and approximately 1,200,000, including Boston and Brookline, are within a five-cent fare



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either Middlesex Fells or Revere Beach, or both, and yet for the lack of this highway have practically no direct highway or parkway communication with the parkways of the Metropolitan System north of Charles River. It is evident, therefore, that this boulevard-highway would not only be a benefit to the cities and towns of the District and those beyond, as providing reasonable access by Massachusetts Avenue and Harvard Bridge to the newer parts of Boston, in which are now located the Opera House, Symphony and Horticultural halls and the Art Museum, and to the highways and parkways west and south of Boston, but, even more, it would be a benefit to Boston itself and to all the cities and towns south and west by providing a reasonable communication with the northern park systems and with all the North Shore and other northern portions of Massachusetts. It would also be an especial benefit to Boston in the relief which it would give to highways, subways and car lines in the older part of the city, by diverting from them travel which now uses them merely to pass into the heart of the city and out again to points beyond.

For years the only barrier to immediate provision being made for this much-needed avenue of communication has been a hesitancy as to incurring its probable great cost. Meantime, its cost has been increased by the natural increase in real estate values and in the cost of construction work, and its cost is likely to continue to increase in the future. On the other hand, the parkways of the Metropolitan System with which it would naturally connect have been largely completed, and the necessity for its construction has become more evident. Fortunately, too, the coming into increased use of automobiles has so changed the character of pleasure travel that, like all other classes of travel, it may be provided for in common with other classes of travel, by a single broad boulevard-highway of excellent surface and alignment, rather than by a parkway, and the cost thereby kept substantially that of the previously suggested more elaborate forms of parkway construction.

The Joint Board has made a preliminary and somewhat detailed examination of all the feasible routes for this boulevard-highway, and has reached the following general conclusions. The northerly terminus must be at the Metropolitan Parkways

at Broadway Park in Somerville near Wellington Bridge over Mystic River. From this point toward the north good park roads now exist or are assured by Fellsway and the Mystic River Driveway and Revere Beach Parkway to all parts of the northerly half of the Metropolitan District, and thereby to the northern portions of the Commonwealth. From Broadway Park toward the south the contour of Prospect Hill in Somerville makes it practically necessary that the route should run to Cross Street Bridge over the Southern Division Railroad, if it is to have a reasonable gradient. From that point two routes suggest themselves: one by Medford Street and Portland Street to Harvard Bridge; the other by a curve around the base of Prospect Hill to the new bridge over the Fitchburg Railroad at Webster Avenue, and thence by Webster Avenue and Portland Street to Harvard Bridge, or by using either Winsor, or Columbia, or Elm, or Norfolk Street, or some combination of them, from Webster Avenue to Massachusetts Avenue. (See plan opposite.)

The Joint Board deems the route by Medford Street and Portland Street, which is that suggested in the report of the Metropolitan Improvements Commission, impracticable, because it would require widening of a crossing beneath the Fitchburg Railroad at a point where adequate widening could be had only by cutting off the buildings of the New England Dressed Meat and Wool Company, formerly Squire's, and because the highway beyond is so close to the Grand Junction tracks for a long distance that it will always be largely occupied by heavy freight. Consideration has therefore been given chiefly to the second route and its various modifications. If a continuous ample highway free from grade crossings is desired for the entire distance from Harvard Bridge to Broadway Park, the only practicable route appears to be by Webster Avenue and Portland Street to a junction with Massachusetts Avenue at or very near Harvard Bridge. The entire assessed value of the real estate for such a route would be approximately \$1,200,000, and the additional construction cost would be \$600,000 for macadam, \$800,000 for tar macadam and \$1,000,000 for stone or wood block pavement. A percentage would have to be added for the cost of real estate above its assessed value, which in the

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case of this route would not be excessive, because along Webster Avenue the buildings are generally of moderate value.

If, on the other hand, it be deemed feasible to effect a junction with Massachusetts Avenue at a point farther from Harvard Bridge and before the crossing of the Grand Junction Railroad is reached, in the expectation that Massachusetts Avenue will be of sufficient width to provide for both present and future travel, and in a reasonable expectation that the Grand Junction crossing will soon be eliminated, a saving in cost of construction may be effected by the use of Winsor Street widened. Columbia Street or Norfolk or Elm streets would furnish an even shorter route; but the land cost by either would be enough greater to wipe out whatever advantage might be gained by a saving in construction. By making use, however, of two of these streets without widening, as one-way streets, and providing small park areas at the points of connection with Webster Avenue and Massachusetts Avenue to emphasize and facilitate connection, a saving in combined land and construction cost of perhaps \$500,000 might be effected; and, if the incidental park areas were omitted and the new boulevard-highway were to end at a point where communication might be made with either Norfolk, Columbia, Elm or Winsor streets, a still greater saving might be effected.

In favor of the first route, that is, the continuous one to Harvard Bridge, it may be said that it is the only open route for crossing the Grand Junction Railroad by bridge which now remains available; and, if adopted, it would add to present highway accommodation for the entire distance to Harvard Bridge by a route free from the increasingly serious obstruction of the Massachusetts Avenue grade crossing, and also facilitate travel toward the Dam and Craigie Bridge as well as toward Harvard Bridge; that it would require condemnation of fewer excellent buildings, and would consequently tend to a greater improvement of neighboring real estate values than any other route; that in the event of excess condemnation of real estate being authorized by adoption of the constitutional amendment for that purpose, it would seemingly be possible by this route to condemn both sides of Webster Avenue, and, after taking out all the land needed for the highway, re-lot and

sell the balance at a price sufficient to recoup the cost of the excess taking and a substantial portion of the land required for the highway.

In favor of the other routes are the saving in cost in the case of the two-way route, and the relatively small destruction of existing frontages on streets where, because of the general excellent character of the dwellings, material improvement in existing values is not to be expected, and the fact that in the case of Norfolk or Columbia Street junction with Massachusetts Avenue would also be made with Brookline Street, which leads to the bridge to Cottage Farms.

Upon all these facts the Joint Board is of the opinion that the complete highway from Broadway Park to a point near Harvard Bridge is best for the Metropolitan District, and worth its extra cost; and worth more also to Cambridge in the relief from the burden of metropolitan travel which it would bring, and in the local improvement to values in a region which will otherwise improve very slowly.

The Old Colony and Cambridge-Somerville boulevard-highways are clearly metropolitan projects, which will provide new radial highways, with parkway features and usefulness, from the very heart of Boston to connection with the Metropolitan Park System north and south. They would be avenues for all classes of travel from many cities and towns of the District in and out of Boston, as well as connections between portions of the Park System which are now difficult of access from Boston. They are clearly extensions of and connecting links in metropolitan work already entered upon. They are recommended as additions to the Metropolitan Park System, to be provided for by appropriations in addition to the metropolitan park loans, series 2; and bills to that effect are submitted herewith. (Appendix, pages 105, 107.)

3. Certain Streets in Boston.

While recommendation is made at a point further on in this report for dealing with metropolitan highways in general, it is to be added that there are certain improvements in highway facilities, especially within the city of Boston, which are of such immediate importance that the Board ventures to make sugges-

tions in regard to them at this time for the purpose of urging that action be taken in regard to them by the municipal authorities in advance of action by a district highway board; and that, to bring about this result, the Legislature, if it deem wise, take immediate action to require the improvements. They are as follows:—

(a) *Arlington Street Extension.*

Extensions and improvements of highways may be considered to be matters of metropolitan concern whenever they would provide thoroughfares for approach to the Metropolitan Park System, or connections between different parts of that system, though of short length or wholly within the limits of a single municipality or district, or in a form adapted to all classes of traffic without the character of a boulevard or parkway; or whenever they would be new highways or extensions or alterations in existing highways to provide for the convenience of traffic and travel of all classes through and about the Metropolitan District by increasing the number, length and usefulness of what are commonly referred to as radial and circumferential highways. From this standpoint it may be considered that extension of Arlington Street in the form of an ample highway from Castle Square to the present Arlington Street at Boylston Street by a widening of Ferdinand Street, and extension across the vacant land formerly occupied by the Boston & Providence Railroad station, and through the single row of estates intervening between that land and Boylston Street, would be a highway of metropolitan importance and concern.

Castle Square will be a natural gathering point for all classes of pleasure travel, as well as traffic, from the suggested Old Colony boulevard-highway; that is, from South Boston, Dorchester, Quincy and the southern portions of the Metropolitan District, as well as from Washington Street, Shawmut Avenue and Tremont Street; and a new highway from Castle Square to Arlington Street would cross Columbus Avenue and connect with Boylston Street, Commonwealth Avenue, Beacon Street and Charles River Embankment. It would be a new and important circumferential highway, facilitating connection with every radial highway and parkway in the south half of the

Metropolitan District, as well as with Charles River Embankment and the bridges and highways which give connection to the radial highways west and north of Boston.

The present is an opportune time for laying out such a highway, because so much of the property on Ferdinand Street is either unoccupied or of low valuation, and the Providence Railroad lot is unoccupied, and, together with the row of estates between it and Boylston Street, is controlled by trustees who are perfecting plans for development, and would therefore be likely to make more favorable terms than can ever again be secured.

(b) Highway Approach to the Charles River Dam.

The approach to the Charles River Dam by Leverett Street is very inconvenient. Opportunity for improving these approaches is now available along the line of the location of the Elevated tracks to East Cambridge. A broad highway may be laid out over this location from Leverett Street, at a point near the dam, to Lowell Street at or near Minot Street. Lowell Street is a wide street leading into Causeway Street, and there connecting with other streets which are already ample for present and future needs. The new street and those with which it would connect would provide an ample new highway as an approach to the dam and the important radial highways to the north and west of the Metropolitan District. (See report and plans by Arthur A. Shurtleff, Appendix, page 108.)

(c) Pleasant Street Improvement.

Pleasant Street makes connection with Broadway at Washington Street and with Charles Street at Park Square. In its present narrow and crooked form it is a barrier to communication between Broadway and Charles Street. If improved by widening and straightening, it would form, with other streets and the extension recommended between the Charles River Dam and Lowell Street, a circumferential highway close to the business center of Boston which would cross every radial highway from that business center to all parts of the Metropolitan District, and give relief, at a relatively small cost, to the highways within the business center, and increase the availability and value for business purposes of much property now

difficult of access and consequently of low valuation. Many other benefits would result from an improvement of Pleasant Street, not the least of which would be that of making it possible to extend the South Boston cars to a connection with the subway entrance of the Tremont Street Subway, and so provide for easier access to and from South Boston and Marine Park.

(d) *New Highway between North and South Stations.*

Between the North and South stations existing streets are indirect, and at many points inadequate even for present needs. A cross-town traffic street between these important points has been urged by merchants and teamsters for many years. Travel from all parts of the District north of Charles River gathers at Causeway Street near the North Station, and, in common with that from the North Station and freight terminals, suffers from the inconvenience of the present streets leading to the South Station and freight terminals and to the southern portions of the District; while, on the other hand, much of the travel from the south portion of the District gathers about the South Station, and, in common with travel from that station and freight terminals, is inconvenienced in reaching the North Station and terminals and portions of the District to the north and west.

The expense of a new cross-town street between these stations has prevented its being laid out in previous years, and even now it is thought possible only because of the suggestion that it may be laid out in connection with a proposed railroad tunnel between the North and South stations at a greatly reduced cost.

Examination of a feasible route for such a highway, in connection with the building of a tunnel, has been made by Mr. Leslie C. Wead, for the purpose of estimating the cost of the real estate; and his report is transmitted herewith, together with separate estimates made by him of the real estate cost for the highway alone; and for the highway together with an estimate of the net cost if remnants of lots should be taken and subsequently sold to the extent permitted under present laws; and a still further estimate of the net cost in case larger acquisitions should be made and subsequently sold, as contemplated by the constitutional amendment permitting such

acquirements in excess of actual requirements, so as to permit rearranging of estates which may front upon the new highway in form suitable to permit of erection of buildings corresponding to the facilities to be furnished by the new highway. (Appendix, page 110.)

These estimates are summarized and discussed in another part of this report, in connection with consideration of the project for a tunnel between the North and South stations, and the saving which might be made in such tunnel if it were built in connection with this highway.

IV. A SYSTEMATIC METHOD OF INTERNAL COMMUNICATION BY HIGHWAYS.

The report of the Metropolitan Improvements Commission recommended that provision be made by law for an adequate and convenient system of metropolitan highways by such alterations and extensions of the principal existing highways of the District, and by such additional highways as might together form such a system. In support of this recommendation many existing highways and possible improvements were referred to and plans submitted to show what might be accomplished if the whole matter of highways were under general supervision and control.

This broad recommendation meets the approval of the Joint Board, and it therefore recommends that the entire matter of the investigation, supervision and decision incident to providing such a system of metropolitan highways be delegated to some continuing board, with adequate authority, and with more time for its work than that allowed to the Joint Board for its report. It does not seem wise, however, that this recommendation should result in the creation of a new board. Further recommendation is therefore made that the Board to which these matters are delegated should be one of the existing State or metropolitan boards, or a board made up of two or more such boards, or of members from such boards, and that reference shall be in the first instance for preliminary report. For carrying out these recommendations a bill is presented which provides that the matter be delegated to such a board, with funds and authority for preparing a plan designating the

isting highways which, in its opinion, should be classed as metropolitan ways, and the lines for extensions of these highways and for new highways necessary to a system of metropolitan ways; and that such board shall report in print, with adequate maps and plans, to the Legislature. (Appendix, page 114.) The Joint Board ventures to suggest further that if, after such report, it seems wise to the Legislature to make permanent provision for a system of metropolitan highways, it be done under a bill creating a permanent Metropolitan Highway Board, and giving authority to such board to continue the investigations already made, and to designate by plan duly recorded the highways and extensions or additions thereto which it deems necessary for a system of metropolitan highways; and to provide for their location and construction, and for all these purposes to maintain offices and employ assistants and incur expenses within the limit of appropriations, the same to be assessed upon the several cities and towns of the District according to valuation; and that after recording of such plan no action shall be taken by local or other authorities in regard to alterations or extensions of the highways or new highways along the lines designated without the approval of the highway board.

A TUNNEL BETWEEN THE NORTH AND SOUTH STATIONS,
WITH OR WITHOUT A HIGHWAY OVER IT.

Chapter 112 of the Resolves of 1910 reads as follows: —

RESOLVE TO PROVIDE FOR AN INVESTIGATION RELATIVE TO THE CONSTRUCTION OF A TUNNEL BETWEEN THE NORTH AND SOUTH STATIONS IN THE CITY OF BOSTON.

Resolved, That the board of railroad commissioners, the board of harbor and land commissioners, the Boston transit commission and the metropolitan park commission, sitting together as a joint board under the provisions of chapter one hundred and thirteen of the resolves of the year nineteen hundred and nine, are hereby directed to hold public hearings on the advisability of constructing a tunnel between the North and South stations in the city of Boston; on the question whether such a tunnel should be built and owned by the commonwealth, by the city of Boston, by a railroad company or companies, or by some holding or terminal company; on the terms upon which said tunnel should be constructed; and, in case the tunnel should not be constructed by the commonwealth or by the city of Boston, on the terms upon which the tunnel

might be acquired either by the commonwealth or by the city. Said joint board shall report its conclusions in print to the next general court on the first Wednesday of January, nineteen hundred and eleven, especially giving its reasons for recommending either public or private ownership of the tunnel; and the board is also directed to report at the same time a bill providing for the construction of the said tunnel and fixing the route therefor, or, if it is impossible to determine a route at the time aforesaid, to provide in the bill that the determination of the location of the tunnel shall be left to some public board or boards.

In compliance with the foregoing resolve, the Joint Board on Metropolitan Improvements has held public hearings, duly advertised, and has investigated the questions referred to it, and now reports thereon as follows: —

The questions submitted by the resolve may be shortly restated as follows: —

First. — The advisability of constructing a tunnel between the North and South stations in the city of Boston.

Second. — Whether such tunnel should be built and owned by the public, or by one or more corporations.

Third. — What terms of construction and acquisition should be prescribed.

The advantages of a short and speedy connection between the two great terminal stations of the city of Boston are manifest. Such a connection must necessarily be made through the most congested section of the city proper, and a tunnel on a proper route presents the most feasible method of securing this result. Such a tunnel should be of sufficient capacity for the proper movement of both passenger and freight traffic. After its opening for use it would enable passengers, both through and local, to continue on through and from either terminal station *via* the tunnel to the other terminal station, and it would thus physically connect the three large transportation companies now serving the city of Boston and its suburbs. It would also tend to the speedier movement of freight, and would to some extent relieve the congestion of city streets so far as due to the transfer of passengers and baggage by vehicles. The area now devoted to passenger car yards near the heart of the city would be released from this use, and these yards would probably be placed at suburban points where land is cheap and now easily av

and the area of land in the yards would thus be made available for business occupation.

The unity of control of the two railroads, resulting in the recent selection of a single individual to be the executive head of both, will doubtless make the proposed tunnel connection between the North and South stations more attractive to these companies; and, in view of this unity of control and management, the Board believes it to be preferable that the tunnel should be built and owned by one or more existing railroad corporations, organized under the laws of the Commonwealth, rather than by the Commonwealth itself or by the city of Boston. While we see no objection to the construction of this tunnel by some holding or terminal company, we see no apparent advantages in such an arrangement sufficient to lead us to suggest such course. If, however, the Commonwealth or the city should desire to construct and own the tunnel, we see no special objection to having such a plan followed, other than the very large expenditure of public money involved, if a satisfactory lease can be made; but the adoption of such a plan would, in our opinion, tend to delay, and would raise various difficult questions between the company or companies and the public authorities, which would be avoided if the tunnel were built by private enterprise. Moreover, the whole proposition is so largely a matter of railroad connections, affecting not only suburban but through business, both passenger and freight, that it involves weighty reasons against public ownership. The expenditure necessary to construct and equip the tunnel for use will certainly be very heavy, and we believe it best that the hazard of the enterprise should be sustained by the railroads rather than by the public.

Certain proposals, by way of studies, preliminary sketches and plans, have been prepared by the New York, New Haven & Hartford Railroad Company, which has thus shown not only an interest in the enterprise, but a desire to consummate it. Without undertaking at this time to pass upon these plans, other than to say that they have been examined and considered by us without prejudice, it is obvious that the carrying out of the whole enterprise is largely dependent upon the route to be selected. The location of the tunnel, its termini and the con-

nection of its tracks with those of existing railroad companies are features which cannot properly be passed upon until the route itself has been definitely selected. Ample provision should be made, in any authorizing legislation, for a taking of the tunnel by some public authority; and to that end a provision should be made in such act, in addition to that contained in general laws, defining the terms upon which the tunnel may be so acquired.

The Joint Board on Metropolitan Improvements therefore specifically answers the inquiries of the General Court as follows: —

First. — It is advisable to construct a tunnel between the North and South stations in the city of Boston.

Second. — Such tunnel should be built and owned by a railroad company or companies.

Third. — The tunnel should be constructed upon such terms as will permit a taking by the Commonwealth.

The resolve further directs the Board to report a bill providing for the construction of the said tunnel, and fixing the route therefor; or, if it is impossible to determine a route within the time allowed, to provide in a bill that the determination of the location of the tunnel shall be left to some public board or boards.

In pursuance of this direction a bill is annexed to this report (Appendix, page 115), which makes due provision for the determination of the location of the tunnel, for a taking by the Commonwealth, and for the other features which, in the opinion of the Joint Board, are essential to properly safeguard the public interest.

EXCESS CONDEMNATION OF LAND AS AFFECTING HIGHWAY AND TUNNEL QUESTION.

The effect of the pending constitutional amendment, providing for “excess condemnation” of land, if adopted, and of appropriate legislation thereunder, upon the financial feasibility of the proposed laying out and construction of a new highway between the North and South stations in Boston, in connection with and on the line of the proposed railroad tunnel between those stations, is a subject which the Board deems it proper to discuss.

In view of the fact that estimates of the probable cost of such a highway, laid out upon certain suggested lines, had been prepared in 1909 by Mr. Leslie C. Wead, it was deemed advisable to request him to prepare revised estimates based upon takings under the present law, and also an estimate based upon taking such estates as could be taken if the proposed amendment of the constitution should be adopted, and as would be required in order to ensure a proper development of the property abutting on the new thoroughfare. A copy of the report of Mr. Wead, under date of Nov. 4, 1910, is herewith submitted. (Appendix, page 110.)

The report presents two estimates based upon action under the present law: the first estimate contemplating the taking of the whole of the 158 estates of which any portion falls within the lines of the proposed highway; the second including the taking of only such portions of such estates outside of the highway line as may properly be classed as remnants, unsuitable for independent development. Mr. Wead very properly suggests, however, that it may not be safe to assume that estates of which only a small portion would fall within the lines of the highway could legally be taken under the present law. His figures based upon the payment of 25 per cent. in excess of the latest assessors' valuations, show a total estimated cost of \$9,885,750 for the taking, under the first plan, of the whole area of the 158 estates affected. Estimating the saleable value of the remainders of such estates, not falling within the highway, at \$25 a foot, we have the total sum of \$4,836,850, the deduction of which from the above-named total cost would reduce the net cost of the land required for the street to \$5,048,900. Remainders of estates on the above basis amount to about 193,474 square feet, out of a total area taken of 405,900 feet, so that nearly 2 feet of land would be thus taken for every foot actually required for the street.

On the basis of taking remainders of estates only in those cases in which these would properly be classed as remnants, not large enough to be available for improvement by themselves, Mr. Wead reduces the area taken outside of the highway to 48,274 feet, of which he estimates the valuation for re-sale to be \$1,094,870, making the total net cost of such land \$5,339,720.

On this basis he makes a much larger allowance than 25 per cent. in addition to average assessed valuations per square foot, on account of the taking covering only portions of estates. While the net cost of land required for the highway under this second plan is estimated to amount to \$290,820 more than under the plan first above mentioned, we believe that under the present law it is the better and safer plan of the two to adopt, particularly in view of the fact that it involves a gross investment of only \$6,507,450, as against a gross investment of \$9,555,750 under the first plan.

If the proposed constitutional amendment and legislation in accordance therewith were in effect, Mr. Wead estimates that, in addition to the 138 estates falling wholly or partly within the lines of this highway, 121 other estates, having a total assessed valuation of \$3,508,100, and valued with the 25 per cent. additional all wanted, as above, at \$4,385,125, might properly be purchased. This third plan would raise the total cost of land takings to the gross sum of \$14,270,875. In this case the total area taken would be 920,004 square feet, and there would remain the sum of 7,108 square feet, thus, for every square foot actually taken for the highway nearly 2 square feet additional would be taken for subsequent resale. Estimating these additional takings as having a salable value of \$25 a square foot, the sum of \$1,777,010 is thus arrived at by Mr. Wead as a deduction from the gross cost, bringing the net cost of the land on this basis down to \$12,493,865.

The question is, therefore, whether such possible saving under the third plan, amounting to \$1,777,010, in comparison with the second plan as above, would warrant the far larger original investment which would be required, such increase being \$7,763,450, or the difference between \$4,616,415 under the second plan and the above sum of \$12,493,865 under the third plan, less the "net cost" plan. A was the assurance of realizing this saving value to which the investor is entitled to warrant such a large expenditure of public money in a real estate operation. We see in this possible reduction in the net cost of the highway through such large additional investment in real estate would be realized and, in case of the immediate re-sale of the same

taken and not required for the street, which of course cannot be counted upon. There must at the best be a large loss in interest and taxes during the period between the dates of takings and the dates of re-sale of land. Assuming that it might require an average period of five years for this purpose, and that the city can borrow money at $3\frac{1}{2}$ per cent., there would be a loss of $17\frac{1}{2}$ per cent. for interest upon the large additional sum to be invested as above, to which must be added loss of five years' taxes at say \$16 a thousand, which would be 8 per cent. additional, or a total of $25\frac{1}{2}$ per cent., or nearly \$2,000,000 in addition to the sum of \$7,763,425, as above figured. But perhaps a still stronger objection to the making of this large additional investment is the great uncertainty as to whether all of the estates included within the limits of the "excess condemnation" would be sold at all within any reasonable period of time at the estimated prices. Moreover, serious doubts have been raised as to the practical workability of the "excess condemnation" idea as formulated in the pending constitutional amendment, and it is questionable whether legislation under such amendment could be carried into effect in the case of this proposed highway without serious and long-drawn-out litigation, which might be carried to the Supreme Court of the United States.

It seems exceedingly doubtful whether the general application of this idea along the whole route of this proposed highway would result in any financial economy; although without this general application there may very likely be cases where it would be desirable to resort to "excess condemnation" at some points along the proposed route.

In considering this matter, it should be borne in mind that through the construction of the highway in connection with the tunnel a saving of \$2,000,000 would be made in the above figures, covering the estimated cost of land takings under the offer of the railroads to contribute this sum, thus reducing the net cost of such takings under Plan 2 from \$5,339,720 to \$3,339,720. Probably the latter sum could further be substantially reduced under the second plan, through the assessment of betterments upon all estates benefited by the improvement,

particularly if the full benefit realized by such estates were assessed upon them, instead of 50 per cent. of such benefit, as provided by the general law now in force in the city of Boston. If it is deemed a proper function of this Joint Board to pass upon the question whether the city of Boston should be authorized or required to lay out such proposed highway in connection with the railroad tunnel, the Board can only state at the present time its belief that the project is worthy of serious consideration, even in the existing condition of the finances of the city of Boston. If such a new highway, which has long been proposed and recommended, is ever to be constructed, the time to do it would certainly seem to be in connection with the building of the tunnel, as it is altogether unlikely that such a large contribution towards the total cost of the highway could ever again be secured.

ELECTRIFICATION OF STEAM RAILROADS IN THE METROPOLITAN DISTRICT.

PREFATORY REMARKS.

This Joint Board has diligently given its attention to the subject of the electrification of steam railroads, and submits on the following pages a detailed report thereon. It may conduce to a clearer understanding of the matter if a preliminary statement is made here.

In its report to the last Legislature this Board recommended the passage of a resolve which should request the railroad companies to make studies and estimates for electrification, and to submit them for the consideration of the Board. It did not recommend, or even suggest the desirability of, any compulsory legislation. The Legislature did not pass the resolve recommended by this Board, but modified it, and added the requirement that this Board should submit this year a bill compelling electrification within a stated time. This requirement has been complied with, and a bill is submitted at the end of this report.

The action of the Legislature, however, and particularly the reports which have since been received from the railroad companies, open the entire question as to the wisdom of any action upon this matter. After most careful study, the

has been compelled to the conclusion that legislation compelling the steam railroads to electrify would be unwise and against the public interest; and that, on the other hand, the wisest course would be to enact no legislation whatever, but to allow the problem to work itself out without interference by the State.

While the Board, therefore, presents a bill as required by the resolve, it does not recommend its passage. The reasons for this conclusion may be briefly stated, referring to the complete report for fuller explanation.

It appears that to electrify the passenger traffic in the Metropolitan District would cost over \$40,000,000. It also appears that experience in New York has thus far shown that electric operation is not more economical than steam operation, but is more expensive, independent of the interest on the capital required for the installation.

Whether the conditions in Boston would be found more favorable is entirely problematical. It cannot be stated with any certainty that they would be. There are many reasons for believing that the opposite might prove to be the case. There are some twenty-one branch lines radiating from Boston as against three in the New York electrification; and the expenditure of the enormous sum above mentioned would only electrify to an average distance of 12 or 15 miles from the terminals, while in New York the expenditure of half as much carries the electrification twice as far. The traffic lines leading from Boston radiate from a center; in New York they run in practically one direction.

There are further elements which complicate the situation here. The lease by which the New York, New Haven & Hartford Railroad Company operates the Boston & Providence Railroad provides that all permanent improvements shall be paid for by the lessee, but at the expiration of the lease shall become the property of the lessor. This, as explained in the report, is a serious obstacle to the electrification of that line, which should in some way be removed before such electrification is undertaken.

Moreover, there are other elements which in the opinion of the Board render unwise at this time the hastening of electrification. In the first place, the best system of electrification

is still undetermined. The situation is somewhat similar to the situation regarding couplers twenty years ago, when no standard form had been adopted. The future relations of the railroad systems cannot be predicted, and it seems unwise to hasten electrification in advance of standardization.

Again, the problem of tunnels connecting the steam railroad stations in Boston is being considered. Any plan for a tunnel would require great changes in the terminals. Electrification should await the determination of this question.

The most serious objection to compulsory legislation, however, arises from the financial results which it would entail. There seems no reasonable ground to suppose that economies would be found that would make electrification profitable to the companies, for a considerable time to come. Judging from the experience in New York, it would entail a loss in excess of the interest on the new capital required. It would thus be necessary to raise the suburban passenger rates in order to furnish the required revenue. Just here is where the situation in Boston is particularly unfavorable. The street car lines radiating from Boston, tributary to the Boston Elevated Railway system, reach out into the suburban districts in all directions, essentially paralleling and competing with the steam lines. They run to Forest Hills, Milton, Newton, Waltham, Lexington, Malden, Winchester, Lynn and beyond. They do not afford as rapid a service as the steam lines, but their cars run often, and carry passengers directly to the shopping district of Boston. These conditions make the short-distance suburban traffic around Boston particularly unstable; and a very considerable increase in fares, such as electrification might make necessary, at least for a time, might easily divert sufficient traffic from the steam lines to the street car lines to make the revenue less with increased fares than it was before with lower fares. Under such circumstances, the revenue required by the roads to finance the cost of electrification would have to be derived from the long-distance passenger traffic and from the freight traffic. Either plan would put the burden where it does not belong.

But there is a still larger question to be considered, furnishing a still more powerful argument against any compulsory legislation. Our railroads are already subject to much

tion by the State. This regulation is principally directed toward three things: the regulation of capitalization; the attainment of safety of operation; and the provision of reasonable rates and fares. Electrification does not fall within any of these classes. It is not a measure of necessity or of safety. It is a luxury, — a luxury which we should all be glad to obtain, but which we may not be able to afford. Furthermore, to provide for the natural growth of the country, our railroads must spend large sums each year for additions to their facilities for handling business, — additions which are necessary, if they are to keep pace with its growth. To raise these large sums of money the railroads are dependent upon private capital, and to no small degree upon foreign capital. This capital is not as willing to invest in American railroads as it once was. It looks with suspicion and fear upon the increasing amount of State and government regulation. The railroads cannot as easily raise the money they need as they once could, and they have to pay higher rates for it. If, now, our State Legislatures begin to enact legislation compelling the expenditure of large sums for what is only a luxury, there is serious danger that the roads will find it difficult to raise the money they need even for necessary improvements. Most unfortunate and serious financial and business results may therefore ensue from compulsory electrification. Massachusetts should not set the example.

The Board, therefore, concludes that the wisest course is to enact no legislation of any kind on this subject. This conclusion is strengthened by the fact that electrification appears to be working itself out without State interference. Rhode Island and Connecticut have enacted no such legislation. In New York the only requirement has been the discontinuance of the use of steam locomotives south of the Harlem River, a distance of 5 miles, on account of the danger of operation in the Park Avenue tunnel. Here in Boston the project for a tunnel connecting the North and South stations is being actively considered, and the New York, New Haven & Hartford Railroad Company has petitioned the Legislature for permission to acquire the control of the Boston, Revere Beach & Lynn Railroad, and to construct a tunnel under the harbor to connect with it. Either of these plans, if carried out, will necessitate electric

operation through the tunnel, and such operation will have to be extended to convenient points beyond the tunnel at each end. This will lead to the extension of the system, and the growth will be gradual, natural, and not forced. Even in this case some increase in revenue may have to be obtained by the roads; but there will be some other economies, due to the tunnel, which will partially offset the cost of electrification.

The full report of the Board now follows.

Chapter 134 of the Resolves of 1910 reads as follows: —

RESOLVE RELATIVE TO THE ELECTRIFICATION OF RAILROADS IN THE
METROPOLITAN DISTRICT.

Resolved, That the railroad corporations operating within the metropolitan district of Boston be directed to prosecute studies with reference to the electrification of their passenger service in said district, and to present the results of such studies on or before the first day of next November to the joint board on metropolitan improvements, created by chapter one hundred and thirteen of the resolves of the year nineteen hundred and nine, and that the said joint board be directed to continue its investigation of this subject and make report thereon in print to the general court on or before the fifteenth day of January, nineteen hundred and eleven, with the draft of an act which shall provide for the electrification of all railroads of standard gauge in the metropolitan district within a stated time, and which shall empower the proper board or boards to determine the manner in which the work shall be prosecuted. [*Approved June 10, 1910.*]

The railroad companies have complied with the requirements of the above act, providing for the prosecution of studies relating to the electrification of their passenger service. Owing to the control of the Boston & Maine Railroad by The New York, New Haven & Hartford Railroad Company, one report was submitted by the latter company, covering the lines of both and the entire South Terminal; while a second report was submitted by the Boston & Albany Railroad (New York Central & Hudson River Railroad Company, lessee). A report has also been received from the Boston, Revere Beach & Lynn Railroad Company. The reports from the companies will be found in the Appendix, pages 121-140.

From these reports it appears that the New York, New F

& Hartford Railroad Company, if it should electrify its lines or those of the Boston & Maine, would contemplate using the same system, with certain modifications and improvements, which it has adopted for the portion of its line between Woodlawn and Stamford, using the overhead system and the alternating current. The New York Central would also contemplate a modification of the system used upon its lines in New York. There, the alternating current is generated and carried at a voltage of 11,000 volts by overhead conductors to sub-stations, where it is transformed and converted to direct current at 600 volts in the third rail. It would propose to use the same system in Boston, except that there would be a voltage of 1,200 volts in the third rail, instead of 600, this being a later development of the art, and one that is considered to be an improvement.

It further appears from these reports that the cost of electrifying for passenger service would be as follows: —

For the Boston & Maine Railroad,	\$18,889,192
For the New York, New Haven & Hartford Railroad, . .	13,862,750
For the Boston & Albany Railroad (including a credit for equipment released),	6,413,300
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Total,	\$39,165,242

These estimates are based upon electrifying the following mileage: —

For the New York, New Haven & Hartford Railroad and the Boston & Maine Railroad.

15.46 miles of four-track road.
 128.07 miles of double-track road.
 32.42 miles of single-track road.
 111.20 miles of yardtracks and sidings.
 Total mileage, 461.62 miles of single track.

For the Boston & Albany Railroad.

20.90 miles of four-track road.
 9.89 miles of double-track road.
 25.00 miles of yardtracks and sidings.
 Total mileage, 128.38 miles of single track.
 | total, 590 miles of single track.

The New York, New Haven & Hartford Railroad estimate is based on electrifying the passenger service only. The Boston & Albany Railroad estimate contemplates electrifying also "some of the sidings and local freight stations on the main line."

It will be noticed that the Boston & Albany Railroad estimate involves a credit for equipment released, which it is believed may be used elsewhere. The New York, New Haven & Hartford Railroad, however, does not allow any such credit. Its remarks with reference to this matter are as follows: —

The electrification of the Boston suburban district would release a large number of steam engines and passenger coaches, which should properly be credited to the construction estimate; but as there is no apparent opportunity for the utilization of so large an amount of equipment of this special type, and as its value for re-sale would be so doubtful, it is not practicable to assign values to this item.

With reference to this credit for equipment released, if such equipment is needed on another portion of the line, where it would obviate the necessity of purchasing new equipment, it would seem proper to allow the credit. If, however, the equipment would have to be sold, it would probably bring much less than its value; and, according to the rules prescribed by the Interstate Commerce Commission, the difference between its cost on the books, as of July 1, 1907, allowing for any reserve for depreciation, and the amount it could be sold for, would have to be charged to operating expenses. This charge, even if distributed over several years, would probably more than offset the interest on the credit, so that it would seem more proper to ignore such credit in considering the cost of electrification, as has been done in the New Haven estimate.

The expense estimated by the Boston & Albany includes not only the cost of electrification itself, — that is, the cost of power houses, shops, machinery, transmission lines, signals and equipment, — but it also includes about \$1,000,000 for track and station changes made necessary. The New Haven estimate, on the other hand, is for electrification alone, and there are other expenses, necessarily involved, which have not been included.

This electrification should presuppose the elimination of at least the principal grade crossings, the expense of which has not been included in the above estimates and which is already authorized by statute. It would also involve considerable changes in tracks, structures and road-bed. For instance, many of the bridges crossing over the New York, New Haven & Hartford and the Boston & Maine lines have too small clearance above the rails to allow for the installation of the proposed overhead system. These bridges would have to be raised, or else the tracks would have to be depressed. Again, costly changes would have to be made at the Back Bay Station, where the present tracks are at an elevation of 8.7 feet above Boston base, or about .5 feet below mean high tide, and some 6 feet below extreme high tide, and where the clearance over the track is entirely insufficient. The addition of the incidental but necessary expenses would considerably increase the figures given above, and would bring the total cost involved in the electrification, for passenger service only, not including grade crossing elimination, to above \$40,000,000.

In studying the estimates of cost submitted by the railroad companies, it must be borne in mind that they cannot be compared on a mileage basis, although the mistake is often made of doing this. The following are the facts: —

Estimate for the Electrification of Railroads in the Metropolitan District of Boston.

Boston & Maine and New York, New Haven & Hartford lines (including South Terminal, but not including incidental charges): —

Total estimated cost,	. . . . .	\$32,751,942
Single-track mileage,	. . . . .	461.62
Cost per mile,	. . . . .	\$71,000

Boston & Albany lines (including incidental charges): —

Not including equipment released: —

Total estimated cost,	. . . . .	\$7,520,300
Single-track mileage,	. . . . .	128.38
Cost per mile,	. . . . .	\$58,000

Allowing for equipment released: —

Total estimated cost,	. . . . .	\$6,413,300
Cost per mile,	. . . . .	\$50,000

Total number of passengers in and out annually:—	
At North Station,	25,750,000
At South Station:—	
New York, New Haven & Hartford	
Railroad,	24,750,000
Boston & Albany.	7,950,000
	<hr/>
	32,700,000
	<hr/>
Total,	58,450,000
All lines in Boston:—	
Total estimated cost, not including equipment re-	
leased nor incidental charges,	\$39,272,242
Total single-track mileage,	590
Average cost per mile,	\$66,000

Electrification in New York.

New York, New Haven & Hartford Railroad:—	
Total estimated cost,	\$6,124,778
Single-track mileage,	118.7
New York Central & Hudson River Railroad:—	
Total estimated cost, including extension to Croton	
not in operation,	\$16,135,000
Single-track mileage in operation,	140.8
Single-track mileage to be added,	87.0
Total mileage electrified when extension to Croton is	
completed, 227.8 miles.	

Grand Central Station, total number of passengers in	
and out annually:—	
New York Central Railroad,	10,261,273
New York, New Haven & Hartford	
Railroad,	9,806,466
	<hr/>
	20,067,739
Total mileage electrified and in operation, 259.5 miles	
of single track.	
All lines in New York:—	
Total cost,	\$22,259,778
Total single-track mileage,	346.5
Average cost per mile,	\$64,200

In comparing these figures, however, it should be remembered that the New Haven estimate for Boston included **not** only the North Station, but also the entire South Terminal, **the** Boston & Albany estimate including only up to the **terminal**.

should also be remembered, with reference to the figures for New York, that the amount expended by the New York Central & Hudson River Railroad covers the cost of the power and distribution system for moving not only its own traffic, but the entire traffic of the New Haven line between Woodlawn and the Grand Central Station, and that it also covers the cost of extending the electrification to Croton, this extension not being completed. For this reason no figures are given for the cost per mile of the separate roads in New York, but only the cost per mile of the total.

The fact that the New Haven estimate per mile in Boston is greater than its cost per mile in New York is, therefore, of no significance, and does not indicate that the estimate for Boston has been too liberal. On the contrary, we are assured that, in making the estimates for Boston, advantage has been taken by both companies, as it of course should have been, of the results of experience in New York and of any economies which have been found practicable in future installations. Thus, we shall later refer to the fact that storage batteries, though used in New York, have not been allowed for in Boston.

Neither do these estimates for Boston indicate which of the two systems of electrical propulsion is the more economical, since the New Haven figures include the cost for both terminals, but leave out some incidental expenses.

The discrepancies in the figures are largely due to the fact, which has been often forgotten, that the cost of electrification depends not only upon distance, but also upon volume of traffic. The power required to propel two equal trains simultaneously is twice as great as that required to propel one. It may cost much more to electrify a certain distance on a line of dense traffic than to electrify a greater distance on a line of light traffic. Not only is the distance to be electrified in Boston, as estimated, much greater than the distance now electrified in New York, but the total number of passengers to be handled in Boston is nearly three times that handled in New York; while the number handled by the New York, New Haven & Hartford and the Boston & Maine lines in Boston is over six times as great as the number handled by the Boston & Albany. These

facts, together with the fact that different systems are used, account for the differences in the estimated costs per mile.

A fairer unit of comparison than the distance is the train mileage. On the map accompanying the reports of the companies the number of daily trains in both directions is shown for the lines of the Boston & Maine and the New York, New Haven & Hartford, and they may be taken from the time table for the Boston & Albany. Dividing the lines to be electrified into sections, and computing the total daily train mileage of each, the following results will be obtained:—

In Boston.

Boston & Maine Railroad:—

Total estimated cost,	\$18,889,192
Total daily train mileage,	7,437
Cost per daily train mile,	\$2,540

New York, New Haven & Hartford Railroad:—

Total estimated cost,	\$13,862,750
Total daily train mileage,	7,375
Cost per daily train mile,	\$1,880

Total Boston & Maine and New York, New Haven & Hartford:—

Total estimated cost,	\$32,751,942
Total daily train mileage,	14,812
Cost per daily train mile,	\$2,211

Boston & Albany Railroad:—

Total estimated cost (not including credit for equipment, but deducting incidental expenses, in order to be on the same basis as the New Haven figures).	\$6,520,300
Total daily train mileage,	3,619
Cost per daily train mile,	\$1,800

All lines in Boston:—

Total estimated cost, as above,	\$39,272,242
Total daily train mileage,	18,432
Cost per daily train mile,	\$2,130

In New York.

Owing to the fact already stated, namely, that the entire New Haven traffic between Woodlawn and the Grand Central Terminal is handled by power furnished by the New York Central, only totals can be given for New York:—

All lines:—

Total estimated cost as above,	\$22,259,778
Total daily train mileage, about	7,760
Cost per daily train mile, about	\$2,870

These figures are closer than the estimates per mile, indicating that the unit is more nearly a proper one. The figures are, of course, not accurate. The cost of terminal work seriously affects the estimate, as well as other factors. Trains are not all alike, and the train mile is not a perfectly correct unit of comparison. A multiple unit suburban train is not the same as a heavy through passenger train. A more accurate unit would be the car mile, or even the ton mile. It is not necessary, however, to pursue this analysis further, and the data are not available. It seems clear that the estimate for Boston agrees reasonably with what would be expected from the experience in New York. It was made, as the reports show, by studying each element separately, — power house, machinery, transmission, equipment, etc., — which is, of course, more accurate than to adopt any single unit of comparison.

In its report of last year, Senate Document, No. 27, 1910, the Board called attention to the fact that the best method to be used in electrification was still undetermined. That such is still the fact is shown by the different systems contemplated by the two roads entering Boston; and, further, by the fact that each proposes some modification of the system which it has adopted at the New York end of its line.

The disadvantages involved in the use of different systems by the two railroads is in some respects not as great in Boston as it is in New York. There, the New Haven trains run over the New York Central tracks between Woodlawn and the Grand Central Terminal, and it was impracticable to equip that portion of the line, including the tunnel, with the overhead system. The New Haven locomotives, therefore, had to be designed so that when they entered upon the New York Central tracks they could take the direct current from the third rail, and the electric machinery in the locomotives had to be adapted for such change in current. Here the trains of each railroad would run **almost entirely** upon its own tracks; to be used by the trains of

with companies, these tracks could be equipped both with a third rail and with overhead conductors. The electric locomotives could be equipped on each line simply for the system adopted by that line. In case the third-rail system should require overhead construction at certain points in the yard, complications might arise which cannot now be formulated.

However, it would be distinctly unfortunate if the two great national systems entering into and operating in our city should adopt different systems of electrification. It would be somewhat similar to a break of gauge. The ultimate relations between these railroads, and the future connections between them, cannot now be foretold. The next twenty or twenty-five years, or even a less period, may bring about changes which would not be believed if they were predicted now; and the expenditure of large sums of money by these corporations to install different local systems might in the future be the cause of great waste and the infliction of unnecessary financial burdens upon them and upon the public. It would seem unwise to unduly hasten electrification in advance of standardization.

The Board also in its previous report made some reference to the advantages and disadvantages of electrical operation, among the advantages being the possibility of utilizing the space over the tracks, the saving in fuel, the diminution of corrosion of overhead structures, the saving of switching in terminals if the multiple-unit system is used, and the added convenience to passengers due to the absence of smoke and cinders.

Some of these advantages are real, and would result in economy of operation. The saving in fuel is considerable and unquestioned. The corrosion of overhead structures, due to the smoke and steam from the locomotives, is diminished in proportion to the amount of steam service eliminated. If the multiple-unit system is used, there are certain savings in train movements, especially if the trains can be run continuously at the loops at the terminals, and do not have to reverse their direction. It is unquestioned that there are elements of economy in standardization which would be immediately felt. There are also some possible elements of economy which may be found to result, but which are more or less hypothetical. For instance, with electrical operation, high train sheds become ~~unnec~~

The trains can be run into a terminal station, occupying simply one story, and the space over the tracks is theoretically available for other uses. Whether it is practically so available will depend upon circumstances, and is a real estate problem. If the operation of trains in a terminal station is by electricity instead of steam, without altering the location of the tracks, it is then a question whether it would pay to put up a building for commercial uses in which the first floor and basement would not be available. If the tracks are depressed, and the electrically operated trains occupy the basement floor, it would then be a question whether the rental which could be obtained from a commercial building on that site, of which no space would be available below the ground floor, would be sufficient to justify the expense of lowering the tracks and constructing the building. In some cases there may be a considerable profit here; in other cases, not. There would be more apt to be a profit if the site is in a large city, where the land is valuable; and in some cases the profit from the real estate investment might be such as to offset to a considerable degree, not only the expense directly connected with the building operations, but the expense of electrification. Such profit, however, is problematical and hypothetical, and cannot be depended upon as an element of economy, like the saving in coal. The New York Central & Hudson River Railroad Company, in its reconstruction of the terminal in New York, intends to erect over the tracks a high building, from which it expects to secure a considerable revenue. The Pennsylvania Railroad Company, on the other hand, whose station is farther down town, and occupies the space under two city blocks, has not planned any such real estate investment on the block occupied by the main portion of the station. This block is covered by a building devoted solely to the purposes of the railroad and its New York offices, and is a comparatively low building. The other block, where the surface of the ground was not needed at all by the railroad company, has been taken by the United States post office. Whether the electrification of a steam road will result in any final economy, independent of the interest on the capital expended, is a matter which cannot be determined by theoretical reasoning, and must be learned by experience. The experience

that there is a through traffic which is handled by steam to the limit of electrification, and that alongside of the electrified passenger service there is a steam freight service, complicates the case, reduces the possible saving and appears to leave a resultant loss. Both the New York Central, and, to a smaller extent, the New Haven lines run a multiple-unit suburban service in and out of New York, in addition to their through passenger service and their steam freight service, and thus far they find the expense greater than before.

The greatest obstacle, however, to speedy electrification is the large capital required, and the fact that the railroad companies would be obliged to pay interest upon the double investment, — that for steam and that for electricity. Furthermore, in order to make electric operation in itself as economical as possible, a considerable portion of the plant for steam operation would have to be abandoned. Passenger coaches which are suitable for steam operation would have to be replaced by multiple-unit electric cars. Round houses, coaling plants, etc., now located at the termini would have to be provided at the suburban points where the steam service would change to electrical service. According to the regulations of the Interstate Commerce Commission, a railroad company is obliged to replace in kind any of its structures or equipment out of earnings. If it abandons a round house and replaces it by another one of the same materials and capacity, it must pay for the new one entirely out of earnings. The same is true with reference to equipment; it must pay out of earnings the book value of the locomotives or cars, less the salvage from them. Independent, therefore, of interest on new capital and of a possible loss from electric operation, which experience thus far indicates to be an actual loss, there is likely to be a further charge upon earnings, due to property replaced. The capital required for electrification, as the estimates of the companies show, is exceedingly large. Not only is the apparatus expensive, but large spare units must be provided. If a locomotive breaks down, it delays in general only the particular train which it hauls; but if an entire power station should fail, all the traffic on the line would be stopped. It is, of course, quite improbable that an entire power station would break down, but it is not beyond the limits of possibility. A boiler ex-

plosion or a fire might produce such a result. The New York Central & Hudson River Railroad Company, in its New York installation, provided two cross-connected power stations, each with a sufficient capacity, utilizing its spare unit and working overload, to carry the entire demand of the service at the rush hours, in case the other power station should fail. Moreover, duplicate transmission lines were adopted in the more important portions of the territory, so that the failure of one of the lines would still leave the other effective. As a still further protection, storage batteries were provided with sufficient capacity to tide over the usual maximum periods of interruption of current supply that experience elsewhere had shown might be expected. These precautions were intended not alone to provide against accident, but also to provide for some future extension of the lines, so that they cannot be said to have been considered necessary entirely on account of the danger of accident. However, it has since been found that the use of storage batteries was unnecessary, and they are not contemplated in the estimate which has been made for the electrification of the lines in Boston. In the New Haven installation at New York, the power station is stated to have an excess capacity of approximately 33 per cent.

The problem of electrification is therefore not only an engineering one, but equally a financial one, involving providing the necessary capital to make an improvement which will result, so far as experience has yet shown, in increased expenditure for operation, with an uncertain increase of traffic to offset it.

It is extremely desirable that electrification should prove to be not only possible, but economical. Such a result is most earnestly desired, not only by the public, but by the railroad companies. It is a cleaner, more convenient and altogether more desirable method of operation than steam. It must be recognized, however, that the state of the art is rapidly changing, and that improvements are being made almost daily. It is a serious question, therefore, whether it is wise by legislative enactment to endeavor to hasten a change rather than to await its natural development. In this connection two points of view are especially to be kept in mind.

In the first place, it must be remembered that the r

companies in this country need to spend very large sums of money each year to provide increased facilities, which are demanded in order that they may be able to carry the increased traffic which results from increasing population and business. Additional tracks, sidings, yards, structures, heavier bridges and equipment, and many other things must be provided. These things are demanded by considerations of necessity. Safety appliances are also demanded for the protection of life, such as block signals, the elimination of grade crossings, and many other expensive additions to railroad property.

Electrification, however, stands in a different position. It is, it is true, very desirable, but its desirability arises not from considerations of safety or of necessity, but mainly, if not entirely, from those of convenience. It is a luxury. The railroads can operate by steam as safely as they can by electricity. How far, then, is it wise to hasten by legislative enactment an improvement which is undoubted and which is desired by every one, but from considerations of convenience alone?

In the second place, our railroads are subject to legislative restrictions of many kinds. They have been required to spend large sums for safety appliances, and their rates are subject to regulation by the State. To raise the large sums of money which they must spend for improvements, they must offer inducements to private capital. Capital, however, is deterred from making investments subject to public regulation which cannot be foreseen and which may be unwise. It is likely, therefore, to be seriously deterred, and the business of the entire country to suffer correspondingly, if it has reason to believe that the State will compel the expenditure of large sums of money which it is not necessary to spend, except from considerations of convenience. A wise and just regulation of the railroads by the State is undoubtedly proper. Railroad operation must be reasonably safe and rates must be reasonable. Capital, if it is assured that such regulation will be wise and just, will not be deterred. The Board is of the opinion, however, that legislation compelling the railroads to adopt electricity as a motive power is unwise and not for the best interests of the public; and that it will make it more difficult, if not impossible, for the railroads to secure the capital which they need for

necessary improvements which the country demands. It should also be remembered, in connection with the electrifying of the lines within the Metropolitan District of Boston, that there are certain elements which make the problem here more difficult, more expensive and less necessary than in New York. These may be enumerated:—

1. In New York, the electrified lines consist of the main line of the Harlem River Railroad from the terminal station to North White Plains, a distance of 24 miles: and of the New York Central main line, which joins the Harlem line at Mott Haven Junction, 5.3 miles from the terminal, to Yonkers, a distance of 14.5 miles from the terminal. The New York, New Haven & Hartford Railroad joins the Harlem line at Woodlawn, 6.6 miles from Mott Haven Junction, or about 12 miles from the terminal, and is electrified to Stamford, a distance of 33.3 miles from the terminal, with an extension of the New Canaan branch 6.13 miles beyond Stamford. The main line from New York, therefore, divides into two at Mott Haven Junction, and one of the latter divides at Woodlawn into two, so that three electrified lines extend out into the suburbs.

In Boston the situation is more complicated than in New York, because not only is the mileage greater here, but there are some 20 main and branch lines leading into the suburbs. Even this number does not comprise all the branches strictly included within the limits of the Metropolitan Parks District. There are other branches diverging within those limits, as, for instance, the Plymouth branch of the Old Colony system, which diverges from the main line to Fall River at South Braintree; the South Boston branch of the Boston & Providence, which diverges at Court St. Junction; the short branch connecting Dedham and Milton; and the South Reading and Newburyport branches of the Boston & Maine, both of which diverge from the main line of the Western Division at Wakefield Junction, and the Swampscott branch, which diverges from the main line of the Eastern Division at Swampscott. A strict compliance with the terms of the bill would apparently require that the bill should provide that short portions of all of those branches should be electrified. As far as railroad systems are concerned, however, the "Metropolitan District" has never been legally defined.

2. The status of the terminals in Boston is very far from permanent, and, indeed, radical changes will be brought about, involving both freight and passenger tracks, if the project for a tunnel between the two stations is carried out. The building of this tunnel would involve a complete rearrangement of the freight and passenger tracks of the Boston & Maine Railroad. It would also involve, to a lesser extent, some rearrangement at the South Terminal. The proposed tunnel under the harbor, connecting the Boston, Revere Beach & Lynn Railroad with the South Terminal, would also involve changes in the tracks, both freight and passenger, at the latter point.

In New York, on the other hand, before electrification was seriously planned, — indeed, in the same year in which the Legislature passed the act requiring electrification, — the city and the railroad companies agreed on changes which were to be made at the terminal, so that plans for electrification could be made with a definite knowledge of what would be the future development of the terminal.

3. The public grade crossings are not yet entirely eliminated in the so-called Metropolitan District. There are 229 still remaining on the New York, New Haven & Hartford Railroad and the Boston & Maine lines.

In New York and vicinity there are no grade crossings on the main electrified line of the New York, New Haven & Hartford Railroad. On the New York Central & Hudson River Railroad there still remain 14 grade crossings on the electrified line, but the more important are under process of being abolished.

It is exceedingly desirable that the principal grade crossings should be eliminated before electrification is carried out. If they are not eliminated, additional expense and waste will be incurred if the large expense of electrification precedes the elimination of these grade crossings, which is sure to follow in the not distant future.

To make the necessary track changes often required in eliminating grade crossings, and at the same time maintain traffic, which is dependent upon bonded rails and a third rail or overhead conductor, adds much to the cost of elimination and the difficulty of the work.

4. The cost of electrification, as contemplated in the so-called

Metropolitan District, is more than twice as great as the cost in New York. Nevertheless, this sum, over \$40,000,000, enables the companies to electrify to an average of much less than 20 miles from the terminals. In New York, on the contrary, an expenditure of about \$22,000,000 enables the companies to electrify to distances of 24, 33 and 34 miles from the terminal, on the three branches respectively.

5. A fifth circumstance which renders the problem of electrification in Boston, in compliance with the apparent desire of the Legislature, difficult, if not impossible, is the situation with reference to the lease by which the New York, New Haven & Hartford Railroad Company operates the Boston & Providence Railroad. The latter road was leased in 1888 for ninety-nine years to the Old Colony Railroad, and the Old Colony Railroad in 1893 to the New York, New Haven & Hartford Railroad. The lease of the Boston & Providence Railroad provides that all improvements made upon the property must be made at the expense of the lessee, and must revert to the lessor at the expiration of the lease without adjustment or compensation. If the New York, New Haven & Hartford Railroad builds a new and more commodious station on the Boston & Providence Railroad line, it pays for it itself; but when the lease expires it must turn the improved station over to the Boston & Providence Railroad without any compensation therefor. If, therefore, the New York, New Haven & Hartford Railroad should electrify the Boston & Providence line, it would have to bear the whole expense itself, and at the expiration of the lease the improvements would be the property of the Boston & Providence Railroad Company. These improvements would make the Boston & Providence Railroad line more valuable than before, and in executing a new lease that road could demand a higher rental from the New York, New Haven & Hartford Railroad on account of them, although the New York, New Haven & Hartford Railroad had made and paid for them. The New York, New Haven & Hartford Railroad would, therefore, be in the position of being obliged to pay rental for improvements which it had itself made and paid for. Furthermore, any expenditures made by the New Haven for improvements on the Boston & Providence Railroad would have to be gradually written off

charged to operating expenses, so as to be extinguished at the expiration of the lease. These expenditures, however, would require capital in the first instance. The State of Massachusetts would, therefore, be obliged, apparently, to authorize the issue of capital for expenditures which were to be charged to operating expenses.

It is usual in railroad leases to provide for an improvement account to which is charged the cost of betterments to the property, if these are made by the lessee. At the expiration of the lease an adjustment is made, and the lessee is reimbursed for said betterments. No such provision exists in the case of the Boston & Providence Railroad lease, and its absence seems to be a serious obstacle to any large improvements, such as electrification, on that line.

The train mileage involved in the electrification of the Providence division is 3,216 train miles, which at the estimated cost per train mile of \$1,880 (see page 56), makes the total cost of electrifying this division \$6,046,000. This amount is *50 per cent. greater than the entire capital stock of the Boston & Providence Railroad*. If the New York, New Haven & Hartford Railroad should be obliged, as contemplated by the resolve, to electrify the Boston & Providence line, it would therefore have to expend thereon an amount in excess of the entire capital stock of the road, and presumably pay an increased rental therefor at the expiration of its lease. It would pay interest on the same, and an annual charge to maintenance sufficient to extinguish the cost at the expiration of the lease, without any compensation or contribution from the Boston & Providence Railroad Corporation. These approximate figures are simply given to indicate that in all probability the cost of electrifying the Boston & Providence, as contemplated in the report of the New York, New Haven & Hartford Railroad Company, would be a large sum, — very likely in excess of the entire capital stock of the road.

As a matter of fact, the electrification of the steam roads in the Metropolitan District could not be undertaken except piecemeal; that is to say, one line would be taken at a time. The work cannot be done at once, nor all at one time, and the operations would disturb traffic more or less while being carried on.

The line to be taken first should be the one most favorably situated, and whose traffic most demands the improvement. Of all the New York, New Haven & Hartford Railroad lines entering the city, the Boston & Providence is probably the one which should first be undertaken. Its grade crossings are all eliminated, and it is four-tracked, nearly or quite to the limits of the Metropolitan District; its local traffic is large; and it is the main through line of the New York, New Haven & Hartford Railroad, and carries probably the largest passenger traffic; yet, on account of the circumstance above recited, the electrification of this line appears impracticable, and will probably remain so unless the obstacle of the lease can be removed.

The electrification of the Boston & Providence suburban district should properly lead within a short time to the extension of the system to Providence. If the ownership of the Providence line were vested in the New Haven road, it is not improbable that this improvement would be made.

Before all the steam lines of the Metropolitan District can be electrified, therefore, some means should be found to cancel the present lease and place the ownership of the Boston & Providence Railroad with the New York, New Haven & Hartford Railroad.

There are several ways in which this might be done, some one of which, in the opinion of the Joint Board, must be used before it can be reasonably expected that the Boston & Providence Railroad can be electrified.

6. It must further be observed that the situation in Boston is not one which affords such necessity for requiring electrification as the situation in New York. Electrification in New York was precipitated by the collision which occurred in the Park Avenue tunnel Jan. 8, 1902, which resulted in the death of a large number of persons. The atmospheric conditions had so obscured the signals in the tunnel that they were almost invisible at any considerable distance. The operation of steam locomotives in a tunnel of any considerable length is undoubtedly not merely inconvenient, but the source of serious danger. The only adequate protection is to have signal towers at each end of the tunnel, and not to allow a train to pass in at one end until the previous train on the same track has emerged :

other end; that is to say, only one train at a time should be allowed on one track in the tunnel. Even then, however, accidents are possible in a double-track tunnel, for an accident may happen to a train on one track which blocks the other track. A safer method, therefore, is to provide that there shall be only one train at a time in the tunnel on any track.

In such a tunnel as the Park Avenue tunnel in New York, which leads into a congested terminal station, such a requirement would be impossible. The traffic could not be handled unless trains were allowed to follow one another comparatively closely in the tunnel, under such safeguards as may be devised. The requirement which led to electrification in New York was, therefore, a reasonable one. Following the accident referred to, the Legislature of New York, in 1903, directed the abandonment of steam locomotives in Park Avenue south of the Harlem River within five years, ending July 1, 1908. The act did not prescribe electrification, but simply the abandonment of steam locomotives. In the same year, as already stated, the city and the railroad companies agreed on changes at the terminal. It will be observed that the New York Legislature required the abandonment of steam locomotives only south of the Harlem River; that is to say, a distance of less than 5 miles. This is a very different matter from requiring the electrification of all steam lines in the Metropolitan District of Boston. As a matter of fact, it was impracticable to terminate electrification in New York at the Harlem River. Just beyond this point was Mott Haven Junction, and the traffic at this point was very congested. It would have been practically impossible to stop all trains at the Harlem River and make the change of power at that point; to do so would have involved greater delay and congestion. It was, therefore, necessary to carry electrification farther out, to points where ample space was available for loops, yards and buildings, and where there was not such a heavy traffic. These illustrations show that no arbitrary line can be fixed within which electrification should be introduced. It would be impracticable to require electrification within the artificial limits of the Metropolitan District of Boston. A reasonable plan would probably involve making the terminals on some lines at points within the Metropolitan District, and on

York City, and its through trains to Washington, the work to include electrification of the freight yard at Harlem River. This fact is sometimes referred to as another apparent indication that electrification is really profitable to the railroad companies, and not difficult to carry out. As a matter of fact, there are exceptional reasons for electrification in this particular case. Since the electrification of the main line had been carried to a point east of the junction of the Harlem River branch at New Rochelle, this branch, if operated by steam, would have been in the nature of an island, with electrical operation on both sides of it. The freight trains and the through express trains which use this branch and are ferried around New York City, would, if this branch were not electrified, have to use steam entirely, even over the electrified main line between Stamford and New Rochelle, or would have to change to electric power at Stamford and back again to steam at New Rochelle. The use of steam locomotives under the overhead system is found to be quite objectionable. It will be seen, therefore, how local conditions rendered desirable the electrification of this branch.

With reference to the smoke nuisance, attention should be called to the fact that not only has this nuisance been very much diminished during the last year or two, but that the Legislature of last year (chapter 651, Acts of 1910) took still further measures to abate it. This act gave to the Board of Gas and Electric Light Commissioners authority to regulate the emission of smoke from all chimneys, including the stacks of locomotives, and provided for a gradual decrease in the density allowed, or in the time during which smoke of a given density shall be permitted. The Board is required to enforce the provisions of the act; to appoint a smoke inspector, who shall engage in no other business, and such deputy inspectors as it may think proper; and any person or any corporation violating any order of the Board is subject to a fine of not less than \$10 nor more than \$50 for the first offense, and not less than \$20 nor more than \$100 for every succeeding offense. Under the operation of this act, and with further efforts on the part of the railroad companies and the Railroad Commission, by the proper instruction of firemen and by other means, there seems little doubt that the inconvenience due to smoke will be still further diminished.

Since experience thus far indicates that electrification is not a source of economy, but rather the reverse, and since a return has to be earned on the additional capital necessary, and a further charge to operating expenses made for property abandoned or replaced, there seems to be no escape from the conclusion that the railroads should be allowed to increase their revenues sufficiently to provide a return on the investment large enough to attract investors. It would not be fair, even if it were possible, to require the railroad companies to expend forty or fifty millions of dollars for electrification in Boston, unless they were also assured of an adequate return on that expenditure.

An increase in the rates of fare, however, might not increase the net revenue. In order to provide for interest on the cost of electrification, what the railroads must have is revenue, rather than an increase of rates.

A reduction of rates frequently increases the total net profits, and an increase of rates may diminish the net profits. If interest on the cost of electrification on certain lines were provided solely by an increase of fares for the passenger traffic affected, it might, therefore, not increase the net revenue. The benefit of electrification in the Metropolitan District would be mostly felt by the short-distance suburban passengers, and the abutters who would be relieved from the annoyance of smoke and cinders. The long-distance traveller would not be especially affected, since the greater part of his trip would still be made with steam locomotives. In strict justice, therefore, if fares were to be increased, the burden should be laid principally on the short-distance suburban traffic. This traffic, however, is likely to be just the kind which is least able and willing to stand such an increase. Moreover, the traffic is precisely the traffic which is least stable, and most likely to desert the steam railroad entirely and patronize the street railway lines, if the latter are conveniently located. It should be thoroughly understood, however, by commuters and others who form the short-distance passengers, that electrification of the steam roads in the Metropolitan District in all probability would, and in all fairness should, lead to an increase in the rates which they would have to pay. The Pennsylvania Railroad, we are informed, has increased all rates for tickets to and from the new terminus

York. Thus to Newark, a distance of ten miles, the price of single tickets has been increased 12 cents, commutation tickets have been increased \$6 per month and 50-ride tickets \$5 a month. For the railroads to gain the additional revenue needed by increasing the freight rates, would be putting the burden where it does not belong, even in a greater degree than in correspondingly increasing the long-distance passenger rates. It should further be said that low suburban rates tend to build up the suburban territory, and to encourage and enable those who receive low wages to live away from the congested center of the city, in districts which are more healthful. From this point of view an increase in the short-distance rates is a distinct disadvantage, and would retard in many cases the building up of suburban territory. Such increase in rates might also lead to the diversion of much traffic from the steam lines to the street railways, and, as has been suggested, result in a net loss to the steam railroads. In such cases, the additional revenue required would necessarily have to be gained from the long-distance passenger traffic or even from the freight traffic, neither of which is benefited at all by electrification. It appears, therefore, that the class of traffic which would most benefit by electrification is the class which is most likely to change and patronize some other form of transportation; that it is the least profitable part of the passenger traffic, and the part which is least able to afford the additional revenues which the cost of electrification would render necessary. For instance, we are informed that business done over the Newton circuit is practically no greater now than it was ten years ago; and if the company should increase the fares, it might not only lead to no increase of revenue, but might even reduce that now existing. In this respect the situation in Boston is distinctly more unfavorable than that in New York. By referring to the map accompanying the report of the New York, New Haven & Hartford Railroad Company, it will be observed that the electrification proposed by that company is essentially confined to a distance of 10 or 11 miles from the center of the city, with the exception of one or two lines which are carried somewhat farther. All of this territory, however, is served by the electric street-car lines connecting with the Boston Elevated system. It would be particularly easy, therefore, in

the case of our Metropolitan District, especially with the improvement of rapid transit facilities by street-car lines into the city and the construction of additional subways, for the traffic to desert the steam railroad lines and patronize the surface systems. This tendency would be increased if any increase of rates should be found necessary on account of electrification of the steam roads.

It should further be borne in mind that electrification would greatly benefit real estate immediately along the lines electrified. Property close to the steam roads is subject to the disadvantages of smoke and noise; it is less desirable for residential or office purposes than that further removed from the line. If, however, the lines should be electrified, the trains would move without smoke or cinders and with less noise, buildings alongside of the tracks would become immediately available for offices, windows could be kept open through the summer without annoyance, and dwelling houses occupied without disturbance. Property of this kind would increase very much in value following the electrification of the lines. We are informed that property along Park Avenue in New York has improved very much in value since electrification has been introduced. Apartments on that avenue which before were almost uninhabitable can now be occupied without disturbance.

Legislation compelling electrification, therefore, would oblige the travelling public, and possibly shippers, to contribute to the improvement of the property of others in which they have no interest. It would, of course, be desirable to have an improvement introduced which would benefit adjoining property, if such improvement could come about naturally; but it would not seem wise to enact legislation which would compel one class of the public to pay for an improvement which would accrue largely to another class.

As a result of the considerations which have been discussed, the Joint Board has reached the following conclusions:—

First.—The electrification of steam roads is a development much to be desired. It would add to the comfort and convenience of the public, and would have advantages for the railroad as well.

Second. — The best method of electrification is still undetermined. The science is in a state of rapid change, and standardization is much to be desired before extensive electrification is undertaken.

Third. — So far as experience has yet shown, the electrification of the terminals of steam railroads under present conditions does not result in economy, but, on the contrary, in increased expense, aside from the interest on the first cost incurred.

Fourth. — If a greatly increased traffic should result from electrification, this expense would be reduced, and might ultimately be changed to a profit.

Fifth. — Electrification would probably result for some time in obliging the railroads to make charges to operating expenses, due to property abandoned or replaced, in addition to interest on new capital and increased expense of operation.

Sixth. — Electrification would, therefore, in all probability require an increase of passenger fares and perhaps of freight rates, to produce the revenue required to pay for it.

Seventh. — Electrification, while desirable, is not necessary, nor is it required on grounds of public safety. It is desirable mainly, if not entirely, on account of added convenience and comfort.

Eighth. — There are other expenditures which should be made by the railroads, which are demanded by considerations of necessity, to enable them to meet the demands of increasing traffic, and which should have precedence of electrification. To compel electrification would postpone these more important improvements.

Ninth. — The railroads are already subject to much regulation by the state and the nation. To require them to expend large sums of money for electrification would make it difficult if not impossible for them to raise the capital required to move the increasing traffic of the country, and would thus hamper industrial development.

Tenth. — As a result of the foregoing conclusions, the Board believes that it is not wise nor in the public interest to enact legislation compelling any electrification of railroads.

Eleventh. — To pass a bill making compulsory the electrifi-

cation of the passenger traffic on all the steam railroad lines in the Metropolitan District of Boston within a stated time, as contemplated by the resolve, would be particularly unwise, because: —

(a) Before such electrification should be carried out, the difficulty presented by the lease of the Boston & Providence Railroad should be removed.

(b) Electrification is contingent upon other needs. Not only is it contingent upon the acquisition of the Boston & Providence Railroad by the New York, New Haven & Hartford Railroad Company, but it is contingent upon a definite decision being reached and a definite plan adopted for the construction of a tunnel between the North and South stations, and the rearrangement of the freight and passenger terminals on the north and on the south. It would be an inexcusable waste to electrify until the plans for these improvements had been definitely decided upon.

(c) The limit of electrification should not be definitely fixed as coinciding with the limits of the Metropolitan District. It should be dependent upon traffic conditions.

Twelfth. — If a tunnel is constructed and used for passenger traffic in Boston, this would necessitate electric operation through the tunnel and for a certain distance on either end, and this would naturally lead to an extension of the electrification to a reasonable distance beyond. If the tunnel is to be used both for passenger and freight traffic, electrification must be adopted for both kinds of traffic. If the tunnel is not to be constructed at all, the demand for electrification is based on the convenience which would result to the public from diminution of smoke and noise; and this demand, if logical, should require electrification for both kinds of traffic.

Thirteenth. — The traffic to be handled in Boston is nearly three times that at the Grand Central Station in New York; and, on account of the radiating traffic in Boston (as compared with the north and south traffic in New York) and the large number of lines in Boston (as compared with the single line with three branches in New York), the expense in Boston is very much greater. There is not sufficient justification for quiring the railroads to spend this sum of money here.

Fourteenth. — If electrification of steam roads, either for passenger or freight traffic, or both, is required by law, it should also be provided that the revenue may be increased so as to afford reasonable compensation to the roads for the expense involved, and in order to make it possible to raise the necessary capital.

Fifteenth. — If the expense of electrification is forced upon the railroads by legislative enactment, a fair increase of rates and fares will be inevitable, and it should fairly be laid upon Boston business. It may prove necessary to increase freight rates for this purpose. An increase of freight rates, such as the railroads are now applying for, is due to the general increase in cost of supplies and materials, and the great increases in wages of employees which have been granted in recent years. Such increase of rates would be distributed over all the traffic, and would not affect the commercial situation of Boston, as compared with other ports. An increase in freight rates or passenger fares, if made necessary by the legislative requirement of electrification in Boston, however, should fairly be laid upon the Boston business exclusively, and might add to the disadvantages under which Boston now labors.

Sixteenth. — The benefits of electrification in Boston will accrue mainly to the commuters and short-distance traffic, and also in a very large degree to owners of property along the lines electrified. To raise suburban fares simply would place the burden where it mainly belongs, but where it is least capable of being borne; and such action would in itself tend in some measure to discourage the development of suburban territory and to divert travel from the steam lines.

Seventeenth. — Electrification is probably the coming form of traction power; indeed, it is not improbable that at some time in the future all the trunk lines of the country over which there is heavy traffic will be electrified. The problem, however, is not like that of providing safety appliances, such as air-brakes, signals, standard couplers, or the abolition of the car stove and replacing it by steam heat from the locomotive. All of these matters were required from considerations of safety. The public demand for electrification, however, arises not from consideration of safety, but from those of convenience.

Considering that there are other improvements which are necessary in order to meet the demands of increasing traffic, the Joint Board believes that an improvement resting on considerations of convenience should be allowed to work itself out without legislative enactment.

Eighteenth. — As stated in another part of the report of this Joint Board, permissive authority should be granted for the construction of a tunnel connecting the North and South stations. If such authority is availed of, it will necessitate electrical operation and will lead gradually to the extension of such operation, as similar causes have led to such extensions in the neighborhood of New York.

Nineteenth. — It should be recognized that all improvements of this kind, whether they are the construction of tunnels or the electrification of lines, which afford greater facilities to the public and involve the expenditure of large sums on the part of the railroad companies, if not offset entirely by increased earnings or reduced expense, should be accompanied by such increase of fares or rates as will enable the roads to maintain a fair rate of return upon their total investment. In all such improvements the public is a partner in the undertaking. The principal benefit accrues to it, with no risk. Its attitude should be such as to encourage the legitimate and economical expenditure of capital, and to compensate it fairly and even liberally for any risks involved. Under the laws of this State there is little danger of a misuse of capital expenditures.

Pursuant to the mandate of the Legislature, however, the Joint Board has prepared the following draft of a bill for electrification, and submits it to the Legislature for consideration, but does not recommend its passage.

AN ACT TO PROVIDE FOR THE ELECTRIFICATION OF STEAM RAILROADS OF STANDARD GAUGE IN THE METROPOLITAN DISTRICT OF BOSTON.

Be it enacted, etc., as follows:

1 SECTION 1. The steam railroads of standard gauge entering Bos-
 2 ton are hereby required to electrify all their lines to such points
 3 approximately at the limit of the so-called metropolitan park dis-
 4 trict as may be approved by the board of railroad commis-
 5 sioners and to complete this work within the period of twelve years
 6 July first, nineteen hundred and two

1 SECTION 2. Whenever, under the provisions of section one, a
 2 railroad company proposes to electrify a line, it shall first prepare
 3 detailed plans and estimates for the same, and submit them to the
 4 board of railroad commissioners, which board, after a public hear-
 5 ing, if it deems such hearing necessary, shall decide whether it is
 6 expedient and in the public interest to electrify at that time the
 7 portion of the line in question; and if it decides that public con-
 8 venience and necessity do so require, shall issue a certificate to that
 9 effect to the railroad company.

1 SECTION 3. Upon the completion of the work, the said board
 2 shall issue a certificate to the said railroad company that it has com-
 3 plied with the provisions of this act, so far as concerns the particu-
 4 lar line upon which the work has been undertaken.

1 SECTION 4. Upon the completion of the work of electrifying any
 2 of its lines, a railroad company shall be authorized to take such
 3 means, subject to the approval of the board of railroad commis-
 4 sioners, as may be necessary to insure additional revenue sufficient
 5 to meet the increased expense in interest and maintenance resulting
 6 from such work.

1 SECTION 5. A railroad company may be exempted from the
 2 provisions of this act with reference to electrification on any of its
 3 lines, if, upon petition to this effect by said railroad company to
 4 the board of railroad commissioners, and after a public hearing
 5 and investigation and an examination of the plans and estimates
 6 by said board, said board shall be of opinion that public necessity
 7 and convenience do not, within the time specified in section one of
 8 this act, require the electrification of said line or lines.

* WALTER PERLEY HALL,

* GEORGE W. BISHOP,

* CLINTON WHITE,

Members of the Board of Railroad Commissioners.

GEO. E. SMITH,

SAMUEL M. MANSFIELD,

HEMAN A. HARDING,

Members of the Board of Harbor and Land Commissioners.

* GEORGE G. CROCKER, *Chairman,*

* HORACE G. ALLEN,

GEORGE F. SWAIN,

* JOSIAH QUINCY,

JAMES B. NOYES,

Members of the Boston Transit Commission.

* WILLIAM B. DE LAS CASAS,
EDWIN U. CURTIS,
DAVID N. SKILLINGS,
ELLERTON P. WHITNEY,
EVERETT C. BENTON,
Members of the Metropolitan Park Commission.

Dec. 31, 1910.

* Those members of the Board whose names are preceded by a star dissent from so much of the report as relates to electrification. Their statements are subjoined.

* The undersigned dissent from so much of the report as relates to electrification, and submit the following statement. Without undertaking to discuss in detail the statements and conclusions set forth in said report, it is enough to say that, taken together, they amount to a declaration that electrification is for the present impracticable. In our opinion, experience elsewhere has demonstrated both the feasibility and the financial ability of railroad corporations to equip a portion of their lines with electricity, and we find no conditions in Boston or its vicinity which lead us to a different conclusion. Indeed, the officers of the New York, New Haven & Hartford Railroad Company have stated to the Commission on Commerce and Industry, and on several occasions to the public, their purpose, if allowed to control the Boston & Maine system, which control is now effected, "to equip both systems with electricity for a considerable distance near Boston." The further proposals of this management to electrify the Boston, Revere Beach & Lynn Railroad, if authority to acquire the same is granted by the General Court, is additional evidence that electrification to some extent is both feasible and within the financial ability of the companies. The studies submitted to the Joint Board by the New York Central & Hudson River Railroad Company for the electrification of certain portions of the Boston & Albany Railroad also indicate feasibility within a cost far from prohibitive.

We are convinced that the public welfare demands some legislation with respect to electrification. While we are not in favor

of legislation compelling the electrification of all steam railroads of standard gauge in the Metropolitan District before a date now to be fixed, we do not believe that leaving the matter in the hands of the several railroad companies exclusively will result in as speedy action as will follow some legislative requirement plainly indicating the policy of the State. Experience has shown that similar legislation as to automatic car couplers, fenders and vestibules for street cars, the prohibition of car stoves, and the like, has been found in the public interest and has accomplished good results.

We are of opinion that any legislation should secure to the railroad companies the greatest latitude with respect to lines first to be electrified; but that the time for commencing the actual work of construction for electrical operation should be fixed at a reasonable date by the General Court or some public agency designated by it, with authority to such agency to extend the time for good cause shown.

WALTER PERLEY HALL.
 GEORGE W. BISHOP.
 GEORGE G. CROCKER.
 HORACE G. ALLEN.
 WILLIAM B. DE LAS CASAS.

* The undersigned dissent from so much of the report as relates to electrification, but are unable to join in the above statement of the views of the minority, for the reason set forth below. We are unwilling to give our assent to all of the arguments, inferences and statements set forth in the majority report, and we believe that its whole tendency is unduly to discourage and postpone electrification, even by the voluntary action of the railroad companies. In our opinion, continued study of the subject under legislative authority, and reports to some public authority setting forth progress made, will tend to advance electrification and to promote agreement upon and adoption of ~~that system~~ of electrical operation best adapted for general use ~~facilitating~~ facilitating interchange of traffic between different ~~therefore~~ therefore believe that legislation should public board to prosecute further

investigations and make report to the Legislature, and requiring the railroad companies, under the supervision of such board, to make further studies, with plans and estimates, not confined within the arbitrary limits of the Metropolitan District, and including freight as well as passenger traffic. We think that it should be left to such board to recommend compulsory legislation if and when it is found to be called for.

We are not, however, convinced of the advisability at the present time of any legislation requiring electrification. The fixing of the time within which the work of construction for electrical operation must be begun by all railroads within the Metropolitan District, even though some public authority is given the power of extending such time for good cause shown, seems to us to be compulsory legislation, the wisdom and necessity of which is yet to be demonstrated. However strong the desire of the public may be that all railroads within the Metropolitan District should be electrified, we doubt whether the problem has yet reached the stage where any form of compulsory legislation is warranted by the facts shown, or will really expedite an intelligent and comprehensive settlement of the question. We also believe that the effect of the great expense of electrification in justifying or requiring an increase in rates of fare within the Metropolitan District should be more fully considered before any form of compulsory legislation is recommended.

CLINTON WHITE.
JOSIAH QUINCY.

APPENDIX.

APPENDIX.

PRELIMINARY REPORT UNDER THE RESOLVE TO PROVIDE FOR AN INVESTIGATION RELATIVE TO PUBLIC IM- PROVEMENTS FOR THE METROPOLITAN DISTRICT.

*To the Honorable Senate and the House of Representatives of the Com-
monwealth of Massachusetts in General Court assembled.*

The members of the Board of Railroad Commissioners, the Board of Harbor and Land Commissioners, the Boston Transit Commission and the Metropolitan Park Commission, sitting together as a Joint Board under the provisions of chapter 113 of the Resolves of the General Court for the year 1909, present a preliminary report, as follows.

The resolve under which this report is made reads as follows:—

RESOLVE TO PROVIDE FOR AN INVESTIGATION AND REPORT RELATIVE TO PUB- LIC IMPROVEMENTS FOR THE METROPOLITAN DISTRICT.

Resolved, That the members of the board of railroad commissioners, the board of harbor and land commissioners, the Boston transit commission and the metropolitan park commission are hereby instructed to sit together as a joint board for the purposes specified in chapter one hundred and eight of the resolves of the year nineteen hundred and seven, and the report transmitted to the general court under the terms of said resolve is referred to said joint board for its consideration. The members of the joint board shall serve without compensation other than their official salaries, but the joint board may expend such sums of money as may be approved by the governor and council, and the expenses so incurred shall be assessed upon the metropolitan parks district. Reports may be made by the joint board to the general court from time to time. A preliminary report shall be made to the general court on or before the first day of January, nineteen hundred and ten, informing the general court whether or not any immediate action by it is necessary or desirable, and if any action or legislation is recommended, a bill or bills shall be submitted embodying such recommendations. A final report shall be made by the joint board to the general court on or before

the first day of January, nineteen hundred and eleven, said report to be accompanied by a bill or bills embodying any further recommendations which may be made.

Pursuant to the foregoing resolve, the members of the said boards and commissions met on July 14, 1909, and organized by the choice of George G. Crocker as chairman and George Lyman Rogers as secretary.

After public notice a hearing was given on July 29, 1909, for the purpose of making assignments for hearing such parties as expressed a desire therefor. Pursuant to such assignments numerous hearings have been held, and the Board has had other meetings for conferences and executive sessions. In addition, sub-committees of the Board have prosecuted special inquiries. The Board has inspected the inner harbor of Boston, and the docks and wharves and principal points of interest about the harbor; the passenger and freight terminals of both railroad and steamship lines; and the latest developments in dock, wharf and terminal facilities, and in electrifying passenger railroad service in and around New York city. The Board has also given consideration to various other matters affecting the commercial and transportation interests of the Metropolitan District. The general subject of the highway and park requirements of the Metropolitan District has also been considered.

The only subjects upon which immediate action by the Legislature seems to this Board necessary or desirable are those hereinafter set forth.

WHARVES AND DOCKS.

East Boston Flats.

There is on the northerly side of the main ship channel a large area of flats and shallow water, owned in three parcels by the Commonwealth, the city of Boston and the United States severally, which may be combined and developed to provide very extensive wharf and dock facilities within the limits of reasonable cost. This area contains about 2,000 acres, exclusive of deep-water channels and islands, and is bounded southerly by the main ship channel, easterly by President Roads and Deer Island, northerly and westerly by Winthrop and East Boston. Within the above-described area are the 100 acres taken by the Commonwealth in 1897, with the flats appurtenant thereto; Apple Island and surrounding flats, and the flats in front of Wood Island Park, owned by the city of Boston; and Governor's Island and flats appurtenant thereto, owned by the United States.

There is no probability that the United States will have occasion to develop its holdings. It may be expected, therefore, that, if a demand is apparent in the future, they will be conveyed to the Commonwealth. Northerly of Governor's Island and extending from President Roads

to Jeffries Point is a natural channel having a depth of 18 to 25 feet at mean low water. This Governor's Island channel could be deepened and widened within the limits of a reasonable cost, provided a large development was undertaken within this area. Probably the dredging of such a channel would be undertaken by the United States.

The Grand Junction Railroad extends through the middle of East Boston to the Cunard and Leyland piers. The 100-acre lot taken by the Commonwealth has shallow water in front of it; while behind it the flats belonging to the East Boston Land Company extend from the Commonwealth land to the Grand Junction Railroad, and are crossed by the Boston, Revere Beach & Lynn Railroad.

To develop the 100-acre lot and flats of the Commonwealth, there must be connections by rail over the flats of the East Boston Land Company across the location of the Boston, Revere Beach & Lynn Railroad to the Grand Junction Railroad and the Boston & Maine Railroad, and an approach by a traffic road. The development of the Commonwealth flats and those of the East Boston Land Company equally require that these connections be made.

In a report printed with the report of the Metropolitan Improvements Commission, Mr. Desmond FitzGerald has submitted alternative plans for the construction of wharves, terminals and warehouses in the large area of 2,000 acres above described. One of these plans suggests the establishment by authority of the United States of a free port on Governor's Island and the flats appurtenant. Another comprehensive plan for developing this area has also been submitted by Mr. George R. Wadsworth.

In view of the general situation, the location and ownership of the flats, the probable demand in the future for increased accommodations for commerce and manufactures, and the still existing opportunity of preserving this fine location for large development, this Board recommends (1) that the city of Boston be requested to convey to the Commonwealth Apple Island and surrounding flats and the flats in front of Wood Island Park, and (2) that the Commonwealth authorize its Board of Harbor and Land Commissioners to acquire such additional land and rights as may be necessary to provide for railroad tracks from the 100-acre lot to the Grand Junction Railroad and the Boston & Maine Railroad, and for a car storage yard and a traffic road; and that provision be made for a crossing not at grade with the Boston, Revere Beach & Lynn Railroad.

Commonwealth Flats at South Boston.

The Commonwealth flats at South Boston are already filled to about grade 14, and ready for rapid development. The main ship channel in front of the pierhead line is completed. The Commonwealth pier is constructed with a berth of 30 feet at mean low water on the westerly

side, and soon there will be 35 feet on the easterly side, and on both sides of the pier a depth of 40 feet can be provided. This large pier with a surface of 11 acres is awaiting a tenant. Other piers 1,200 feet in length can be built as soon as there is a demand therefor. An elevated highway or viaduct can be built from Summer Street at C Street across land of the Commonwealth to the second story of the sheds on the pier. Such a roadway would enable passenger traffic on foot and in carriages to reach the second story of the pier sheds by a safe, convenient and level roadway, and would leave Northern Avenue, connecting at grade with the same piers, entirely for the use of freight and passenger trains and heavy trucks. The freight would be loaded, discharged and carried away on the lower level, while the passengers and baggage would arrive and depart directly on the upper level, without any crossing of railroad tracks at grade.

There are over 90 acres of filled land belonging to the Commonwealth on the northeasterly side of Summer Street ready for use, either for warehouses, car sheds or a freight yard. The Commonwealth also owns over a mile and a half of frontage on the pierhead line of the main ship channel and the reserved channel, all of which may in time, if there is a demand, be developed with piers and berths. It is sufficient to say that this is likely to meet the demands of navigation and commerce on this side of the harbor at least for many years.

This Board recommends that sufficient money be appropriated out of the Commonwealth's flats improvement fund to enable the Board of Harbor and Land Commissioners to construct new piers along this front and otherwise develop the Commonwealth flats, as soon as it is reasonably certain that they can be rented to steamship lines or others at a proper rental, to be approved by the Governor and Council.

This Board approves the policy heretofore pursued, of holding the flats and foreshore in public ownership both in South Boston and East Boston for development in a large way for purposes of general public importance to navigation and commerce, and recommends that this policy be continued in the future.

RAILROAD SERVICE.

The report of the Metropolitan Improvements Commission has called attention to many possibilities of improving both the passenger and the freight service within the Metropolitan District. Most of the suggested changes are predicated upon the substitution of electricity for steam as the motive power.

As the Metropolitan Improvements Commission reported that the question of transportation was the paramount question affecting the commercial and industrial development of the District and of the Commonwealth, and as that opinion has been plainly endorsed by the Legislature and by the public, and is fully concurred in by this Board, it

becomes of primary importance that the work of studying the problem of electrification should be begun at once in a determined and comprehensive way.

To electrify a complicated terminal is no simple undertaking; it involves fundamental changes and very large expenditures. It is very different from the problem of electrifying one or two through tracks for passenger traffic. That electrification for passenger traffic is practicable has been demonstrated in New York City by the New York Central and the New Haven railroads, and in other places both in this country and Europe. Information is meager, however, as to the cost of installation and economy of operation under varying conditions.

The best method of furnishing electric power is undetermined. In New York the respective systems in use by the New York Central and the New Haven railroads are distinctly different. On the former a third rail is used as a conductor, and on the latter an overhead wire. On the former an alternating current is carried at high tension to substations, where it is transformed to a lower voltage direct current and then transmitted to the locomotive by a third rail; on the latter the alternating current is carried at high tension by overhead conductors directly to the locomotive, where it is transformed to a lower voltage. Moreover, electrification for freight traffic, and particularly the electrification of a large freight terminal, is a difficult matter, regarding which there is little or no experience and much difference of opinion.

It is very important that the problem should be solved, and we believe that its study should now be taken up by the railroads and pushed with vigor.

As against the great cost of installation of electricity there is opened the possibility of utilizing in terminal stations and yards the space over the tracks for offices, warehouses, manufacturing plants and roadways. With electrical operation the entire passenger and freight terminal area may be covered with buildings. In the matter of operation there are several elements of saving. One of these is a saving in fuel, owing to the power being generated in a large central plant under most favorable conditions. The consumption of fuel per horse-power is much smaller than that which results from the extremely wasteful method of the steam locomotive. It is estimated that horse-power can be furnished at the locomotive under electrical operation with one-half the consumption of fuel required by our present steam locomotives.

Freedom from locomotive smoke, soot and gas will contribute in large measure to the comfort and health not merely of passengers in the stations and cars, but also of almost every person in the Metropolitan District.

In order that plans may be worked out with due regard for the rights and interests both of the public and the railroads, this Board recommends the passage of the following resolve:—

It cannot entirely fulfil commercial requirements unless individuals and corporations desiring to erect important business and office buildings or warehouses and manufacturing plants can secure suitable lots thereon.

When in the heart of a great city narrow streets are widened, or new broad thoroughfares are laid out, it generally happens that the remnants of those estates of which a part has been taken for the highway are not of suitable size or shape for the construction of important buildings, and that attempts to combine several estates in one ownership in order to make up a lot of good size and shape prove to be futile.

If such a thoroughfare as that now under consideration should be laid out in a city of such irregularity of highways and estates as Boston, and if land takings therefor should extend to the full limit now permitted by law, namely, a taking of entire estates when parts only are necessary for the highway itself (St. 1904, c. 443), it would be found that the remnants of estates not needed for the highway would be misshapen and shallow, and that the efforts of individuals to combine adjoining estates with these remnants so as to form lots suitable for building purposes would be unsuccessful.

For example, on one route which has been suggested as suitable for such a highway and tunnel combined the area of the remnants is 48 per cent. of the whole area of all those estates of which a part is needed for the highway; and these remnants, having a frontage of 5,720 feet, are very irregular in shape, and their average depth is only 34 feet. By themselves they do not furnish suitable business sites.

If, however, takings in addition to these remnants can be made wherever needed to provide areas sufficient for the construction of buildings of large size, then the street will more quickly and surely become an important business thoroughfare, and the commercial and industrial growth and prosperity of the city will be promoted in a larger and more adequate way.

St. 1904, c. 443, previously referred to, provides for the taking of the whole of the estates of which portions only are needed for the highway itself; but that act does not provide authority for larger takings of land, which, in the case of the thoroughfare in question, may prove desirable in order to ensure early development for business purposes; and doubts have been suggested as to whether a statute authorizing such larger takings would be constitutional. This Board therefore recommends that the opinion of the justices of the Supreme Judicial Court as to this matter be requested. Upon their opinion may depend the determination of the question whether such a highway as that herein referred to should be laid out.

HIGHWAY AND PARKWAY IMPROVEMENTS.

Many projects for increasing public convenience by improvements in or addition to the highways and parkways of the District have been brought to the attention of the Board. Most of them are of a sort which must be considered as illustrations of the need for concerted action to provide a more complete system of radial and circumferential highways and parkways by slight improvements and additions to those already existing, and are being considered as such with reference to the possibility of devising a means of providing for such concerted action. Other more important and expensive ones are being considered separately, with a view to the advisability of making specific recommendations as to each. Some have already been reported upon and recommended by the Metropolitan Park Commission as being desirable so soon as the Legislature feels that the District can afford the expense. Among these is one of such pressing importance for the purpose of meeting most economically a present urgent demand, and for the purpose of protecting the usefulness of the driveway along Revere Beach, that the Board deems it wise to single it out at this time for the recommendation that it be at once provided for by an appropriation and authority to the Metropolitan Park Commission. The project thus recommended is that for a traffic road between Revere Street and Lynnway in the town of Revere.

When Revere Beach was acquired as a Metropolitan Park reservation, there was a traffic road along the portion between Revere Street and the Point of Pines, but no traffic connection beyond to Saugus River and Lynn. All public needs which then existed were provided for by the driving road, which was built for pleasure travel and for such traffic only as would be incident to the use of estates abutting on the reservation. Since then the Legislature has directed the building of a bridge and approaches over the Saugus River by the Metropolitan Park Commission, and a State highway from the river to Commercial Street in Lynn; and the city of Lynn, with assistance from the county commissioners of Essex County, has extended this highway to Market Street in Lynn, where connection is made with the highway which is the usual line of travel to Swampscott, Marblehead, Salem and the other north shore cities and towns of Essex County. As a result, a large part of the traffic to and from Essex County seeks an opportunity by these new roads to reach Ocean Avenue in Revere, which leads through another highway to the wharves, docks and ferries of East Boston, and so to the business section of Boston itself. Many requests to use the Revere Beach driveway for this connection have been made to the Metropolitan Park Commissioners; but to grant these requests would require reconstruction of the driveway at great expense in a form adequate to support heavy traffic, and would seriously lessen the usefulness of the

reservation. It is the opinion of this Board that, aside from the question of cost, it is essential that Revere Beach be kept as a park, and that it be protected from all possibility of use as a highway for heavy traffic and electric cars.

The request for a traffic connection between Lynnway and Revere Street is reasonable and urgent, however, and ought to be provided for. Fortunately, the way is still open to provide such a connection at reasonable cost by a road separate from the reservation; and your Board believes that it is true economy to provide for it at once, before the cost is further increased by new buildings or land developments. A bill for that purpose has been drafted, and is presented herewith to the Legislature:—

AN ACT TO AUTHORIZE THE METROPOLITAN PARK COMMISSION TO ACQUIRE LAND FOR, AND TO CONSTRUCT AND MAINTAIN, A TRAFFIC ROAD FROM REVERE STREET TO LYNNWAY IN THE TOWN OF REVERE.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The metropolitan park commission is hereby authorized to acquire land for and to construct and maintain a traffic road in Revere from a point near the junction of Ocean avenue and Revere street to a point in Lynnway near Saugus river, and for that purpose said commission may exercise all the powers conferred upon it by chapter two hundred and eighty-eight of the acts of the year eighteen hundred and ninety-four and acts in addition thereto or in amendment thereof, and may expend the sum of three hundred thousand dollars.

SECTION 2. To meet the expenditures made under authority of this act the treasurer and receiver general, with the approval of the governor and council, shall issue scrip or certificates of indebtedness, bearing interest at a rate not exceeding four per cent per annum, to the said amount of three hundred thousand dollars, as an addition to the metropolitan parks loan, series two, at such times and in such sums as the said commission shall certify to him to be necessary to meet the liabilities incurred by said commission under the acts aforesaid, and shall add to the existing sinking fund to provide for the payment of the same. Such scrip or certificates of indebtedness shall be issued and additions to said sinking fund shall be assessed and collected in accordance with the provisions of sections eight, ten and eleven of said chapter two hundred and eighty-eight and in accordance with the provisions of chapter two hundred and eighty-three of the acts of the year eighteen hundred and ninety-five and of chapter four hundred and nineteen of the acts of the year eighteen hundred and ninety-nine.

SECTION 3. This act shall take effect upon its passage.

EXPENDITURES.

The following is a statement of the expenditures of the Board to date:—

Appropriation, chapter 521, Acts of 1909,	\$10,000 00
Expenditures:—	
Advertising,	\$94 63
Trip to New York,	373 70
Estimates,	500 00
Stenographic reports,	126 00
Carriage hire and sundries,	88 38
Compensation for services of secretary to Jan. 1, 1910,	600 00
	<hr/>
	1,782 71
Balance of appropriation,	<hr/>
	\$8,217 29

The foregoing report is respectfully submitted.

WALTER PERLEY HALL,
GEORGE W. BISHOP,
CLINTON WHITE,

Members of the Board of Railroad Commissioners.

GEO. E. SMITH,
SAMUEL M. MANSFIELD,
HEMAN A. HARDING,

Members of the Board of Harbor and Land Commissioners.

GEORGE G. CROCKER, *Chairman*,
GEORGE F. SWAIN,
HORACE G. ALLEN,
JOSIAH QUINCY,
JAMES B. NOYES,

Members of the Boston Transit Commission.

WILLIAM B. DE LAS CASAS,
EDWIN U. CURTIS,
DAVID N. SKILLINGS,
ELLERTON P. WHITNEY,
EVERETT C. BENTON,

Members of the Metropolitan Park Commission.

JAN. 1, 1910.

REPORT MADE TO JOINT BOARD ON METROPOLITAN IMPROVEMENTS, ON PROPOSED ISLAND IN CHARLES RIVER BASIN.

ROBERT P. BELLOWES & RALPH W. GRAY, ARCHITECTS, 8 BEACON STREET,
BOSTON, DEC. 1, 1910.

[Explanatory notes and sketches presented to the Joint Board on Metropolitan Improvements by Robert P. Bellows & Ralph W. Gray, Architects, in connection with the studies for an island in the Charles River Basin, embodied in drawings of three different schemes prepared by them.]

NEEDS OF THE CHARLES RIVER BASIN.

The main ends sought in projecting this island are to provide:—

1. Suitable sites for boat houses and other recreation buildings.
2. Sheltered river courses and channels for pleasure craft.
3. A more attractive general aspect of the basin.

1. Suitable Sites for Boat Houses.

There is an admitted and pressing need in the basin for sites for boat houses; and the position of the basin in the center of a large population makes the provision of one or more bathing beaches a matter of much interest to the public. The present embankments and public parks and reservations surrounding the basin should not be used for these purposes more than is absolutely necessary. Boat houses would not only be difficult to arrange with the promenades, but would seriously injure the appearance of the basin and obstruct the view of the water from the shores. A suitable island will furnish adequate and easily accessible facilities. An island designed on the lines suggested in the accompanying drawings would provide ample and inconspicuous boat-house sites, which could be conveniently reached from all parts of the Metropolitan District by the Harvard Bridge. The term "recreation" is hereinafter used to include boating, bathing, etc.

2. More Sheltered Waterways.

In a stiff breeze the surface of the basin is now too exposed for convenient use by the lighter kinds of pleasure craft. Some portion of the waters should be more protected. An island would give quiet reaches of water along its shores at all times, particularly if designed with sheltering coves and waterways, and would add much to the safety and enjoyment of the boating public. In winter, inland lagoons would give earlier available and safer places for skating; in summer, they

Scheme A. — A Small Island for Recreation and Boating Purposes Only.

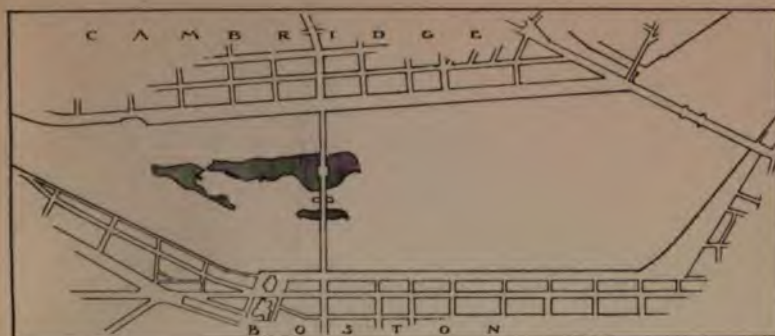
This island, though of no great breadth or area, is of considerable length. It provides a long shore line suitable for boating purposes, and its southerly side is indented with sheltered coves furnishing the best of boat-house sites. In its general mass, this island, when properly planted with trees, would give almost the same landscape effect as the islands of larger area in the other schemes. It is proposed to give it an undulating surface, sloping gently up from the water, and rising high enough at the center to allow easy access from Harvard Bridge, which crosses the island near its easterly extremity. Pleasure and service paths traverse the entire island. Sufficient head room is afforded near the low-lying shores of the island for paths to pass under the bridge where this is necessary.

The present bridge draw and channel are retained; the somewhat unsightly draw is masked, however, by a small wooded island set along the south side of the channel. The main island has small bridged water passages across it at its narrowest points, to allow short cuts for boats from one side to the other. This island is so designed that it may be enlarged and extended, if a greater area is needed to provide a site for the Institute of Technology or for other purposes.

Scheme B. — An Island of Medium Size, combining Facilities for Recreation and Boating with a Site for the Institute of Technology or for Other Purposes.

This scheme would require a new draw between the second and fourth piers from the Cambridge side of the river. Otherwise it is merely an expansion of Scheme A, retaining all the features necessary for recreation and boating purposes, and providing, in addition, an area of 1,000,000 square feet (about 25 acres) in the central portion of the island which could be sold to the institute or some other institution. The entire perimeter of the island would be retained for recreation purposes. Thus the appearance which the island would present from the two sides of the basin would always be controlled, and the public would still possess a fringe of wooded shore with paths around the entire island, as well as a broader area at the western end.

If, for example, the institute bought this property, its needs would not require at once all the area set apart for its uses. With proper restrictions, the portion of the island assigned to it might be filled in gradually, as its needs demanded more space. For the present much of the property so assigned could be left unfilled, as interior waterways and lagoons. The outer fringe of wooded shore should be built at once. This would mask the work of later filling in most effectively, as all of this would then be in the interior lagoons. For want of a better name,



SCHEME A



SCHEME B



SCHEME C

ISLAND IN CHARLES RIVER. — Diagram of Schemes A, B and C, showing Relation of Island to the Basin.

1. The first part of the document is a list of names and titles, including "The Hon. Mr. Justice" and "The Hon. Mr. Justice".

this might be called the "atoll" system of island building. A narrow encircling fringe of land would be constructed, which would give definitely the ultimate mass and extent of the island; the interior filling could come later.

In this scheme (B) the space assigned to the institute is placed conveniently near the bridge, lying on both sides of it. Passages under the bridge would unite this property. The layout of the institute buildings is only tentative, but it is obvious that an orderly arrangement, capable of future expansion, is necessary. In the drawings the administration building and two small flanking buildings are placed on a level with the bridge roadway, forming a small entrance court of honor, from which steps and ramps lead down to the other necessary buildings, placed at a lower level. Economy in cost of filling will best be secured by setting these latter buildings as low as the nature of the site permits; and, moreover, the appearance of the island will be more attractive viewed from the shores of the basin if most of the buildings are kept low.

It would be a simple matter to keep the institute property entirely separate from the parts of the island devoted to public uses, if this should prove desirable. A fence would be required only on one side, as the other sides are separated by lagoons and waterways. Special steps for the public lead down from the bridge directly onto the shore strips. The island is too small for pleasure driving, but access should be possible to all parts of it for service wagons.

Scheme C. — A Larger Island, combining Recreation Facilities and a Site for the Institute of Technology, or for Other Purposes.

This scheme is a variation of Scheme B on a more ample scale. More space is given to recreation purposes, and the entire area of 25 acres devoted to the institute is placed below Harvard Bridge. The shores are devoted to public uses, as in Scheme B. This island would necessarily encroach more on the lower part of the basin, but would still leave a sufficiently large open expanse of water.

APPROXIMATE SURFACE AREAS, CUBIC CONTENTS AND COST OF FILLING
FOR THE THREE SCHEMES.

The surface areas and the number of cubic yards of filling necessary in each scheme have been computed with some care. The contracts made by the late Charles River Basin Commission for recent work of a similar nature along the shores of the basin have been examined, and the probable cost per cubic yard for filling has been estimated from these contracts. Surfacing and landscape work is not included in the estimates.

The following data were used in arriving at an approximate estimate of the cost of each of the three schemes: —

Areas and Cubic Yards of Filling in Each of the Three Schemes.

SCHEME.	AREA OF ISLAND (SQUARE FEET).			Filling necessary (Cubic Yards).
	Recreation.	Institution.	Total.	
Scheme A,	773,000	-	773,000	954,000
Scheme B,	996,000	606,000	1,602,000	1,640,000
Scheme C,	1,514,000	741,000	2,255,000	2,380,000

In calculating the cubic contents of the islands, it was estimated that riprap would lie at an angle of 1 to 1; ordinary earth, at 1 to 5; and sand, at 1 to 10. The contours of the bottom of the river were taken from soundings made in 1902 for the Commission on Charles River dam. There is no evidence that these have changed materially in that part of the river where it is proposed to set the island. The contours of the island have been kept reasonably low, but high enough to allow buildings, other than boat houses, to have basements and cellars which do not go below grade 12. The surface of the water in the basin at present is at grade 8.

Items of Cost of Similar Work of Filling on the Basin, from Recent Contracts and Bids.

TABLE NO. 1.

[Charles River Basin Commission. Contract No. 1, Dam and Lock. Total cost, \$301,607.50. Holbrook, Cabot & Rollins Corporation were given the contract.]

			Charles F. Taylor & Co.	Holbrook, Cabot & Rollins Cor- poration.
Item No. 6, additional ordinary earth,	180,000 cubic yards, at,	. .	\$0 31	\$0 34
Item No. 7, additional clean earth,	50,000 cubic yards, at,	. .	38	40
Item No. 8, additional sand and gravel,	160,000 cubic yards, at,	. .	41	45
Item No. 10, additional coarse gravel,	7,000 cubic yards, at,	. .	70	75
Item No. 11, broken stone or screened gravel,	5,700 cubic yards, at,	. .	1 25	1 50
Item No. 12, riprap of small stones,	4,600 tons, at,	. . . .	1 50	1 50
Item No. 13, riprap of medium stones,	3,700 tons, at,	. . . .	2 00	1 50
Item No. 14, riprap of large stones,	1,400 tons, at,	. . . .	2 00	1 50

TABLE No. 2.

[Charles River Basin Commission. Contract No. 44, Boston Marginal Conduit, Section 3, and Boston Embankment, Section 1. Coleman Bros. were given the contract.]

	Coleman Bros.	Patrick McGovern.
Item No. 2, earth filling, Class A (ordinary earth), 280,000 cubic yards, at, .	\$0 27	\$0 27
Item No. 3, earth filling, Class B (clean earth), 25,000 cubic yards, at, .	50	45
Item No. 4, earth filling, Class C (sand and gravel), 55,000 cubic yards, at, .	50	55

Page 17, Section 10. Permitted to take earth filling from above elevation 80 (grade-20).

TABLE No. 3.

[Charles River Basin Commission. Contract No. 50, Boston Marginal Conduit, Section 4, and Boston Embankment, Section 2.]

	Holbrook, Cabot & Rollins Corporation.	Nawn & Brock.
Item No. 1, earth filling, Class A (ordinary earth), 80,000 cubic yards, at, .	\$0 40	\$0 40
Item No. 2, earth filling, Class B (clean earth), 25,000 cubic yards, at, .	53	60
Item No. 3, earth filling, Class C (sand and gravel), 40,000 cubic yards, at, .	68	65

The above items of unit cost have been taken as a basis for determining the approximate cost of filling for the three schemes. The bulk of the filling required consists of "ordinary earth filling" (Class A), but a certain amount of "clean earth" (Class B) and sand and gravel (Class C) would also be used. The proportion of these different kinds of filling which would be required has been determined by averaging the quantities used in somewhat similar work on the basin, as given in the above tables. In calculating the cost per cubic yard, approximate averages of the prices given in the above three tables have been used, as follows:—

KIND OF FILLING.	Proportion of Total Filling.	Cost per Cubic Yard.
Ordinary earth (Class A),	11 parts,	\$0 40
Clean earth (Class B),	2 parts,	42
Sand and gravel (Class C),	5 parts,	54

An allowance of 20 per cent. has then been added to these figures in making up the following estimates:—

Approximate Cost of Each of the Three Schemes.

Scheme A.—Total area, 773,000 square feet:—

A small island for recreation purposes only, . . . \$500,000
(This figures to about 65 cents per square foot.)

Scheme B.—Total area, 1,602,000 square feet:—

A medium-sized island, with provision for recreation,
and also for a site for the Institute of Technology or
for other purposes, . . . 850,000
(This figures to about 53 cents per square foot.)

Scheme C.—Total area, 2,255,000 square feet:—

A larger island for recreation and for the Institute of
Technology or other purposes, . . . 1,250,000
(This figures to about 55 cents per square foot.)

Possibility of Further Reducing Estimated Cost.

The cost of building one of these islands may be reduced below the sums estimated above.

Material from the Riverbank subway, which is to be built in the embankment on the Boston side of the basin, could be readily and cheaply transported by water to the site of the island.

Further, Mr. Guy C. Emerson, lately superintendent of streets of the city of Boston, estimated that the city could save about \$46,000 a year in carting, if allowed to deposit ashes and other suitable waste material in the basin. He estimated the supply of such filling at 500 cubic yards a day, and the saving to the city at 30 cents per cubic yard; deducting for Sundays and holidays, this supply of filling would be about 153,000 cubic yards a year, which would supply the "earth filling" required as above, amounting to about 583,000 yards, in less than four years.

The causeway across the island would reduce the bridge structure of Harvard Bridge to two-thirds of the present length. The expense of reconstructing and maintaining the bridge would be proportionately lessened.

Distribution of Cost.

The terms upon which the institute, or other institutions, should be admitted to a participation in this island scheme have not been worked out; but it is evident, from the low figures of cost per square foot above given, that the new land thus created would be of greater value than the cost of making it. It would seem that an arrangement for the ultimate transfer of 1,000,000 square feet, for other purposes than recreation, could be made, which would be very advantageous both to the purchasers and to the community.

FUTURE DEVELOPMENT OF THE BASIN.

Two excellent plans have been designed for the future development of a large island in the basin, one by Mr. R. A. Cram, architect, and one by Mr. A. A. Shurtleff, landscape architect; it may prove desirable to carry out some such plan at some later time, and the scheme here outlined would not be inconsistent with this idea. Both these schemes show a long island, set lengthwise in the basin and connected with the two shores by several bridges. In both these schemes a waterway 700 feet wide is left on the Boston side of the basin, and one of 450 feet on the Cambridge side. These are the widths, respectively, of the Thames at London and of the Seine at Paris.

In the less ambitious scheme here presented, the width of the waterways on the two sides of the island are the same as in the larger schemes above mentioned. Thus the small island now proposed, if a larger island were eventually built, might serve as a nucleus for it, and, in the mean time, the smaller island would furnish a pleasant break in an extremely wide and therefore somewhat uninteresting body of water.

SIMILAR ISLANDS IN OTHER CITIES.

There are many examples of similar islands set in mid-stream. Among those most famed for their beauty of effect are Rousseau's Island at Geneva, the picturesque planting at the end of the Pont Neuf at Paris, the Margareteninsel at Budapest, and the charming recreation island in the Moldau at Prague. The wooded causeway in the Alster basin at Hamburg is treated in very much the same manner as here proposed for islands to be placed in the basin. Another good example is Goat Island in the Niagara River.

The above examples show that it is possible to make an island which would greatly enhance the beauty of the basin, and would help to keep Boston the most interesting and beautiful of American cities.

DRAFT OF ACT TO PROVIDE FOR REPORT UPON FURTHER
DEVELOPMENT OF CHARLES RIVER BASIN.

AN ACT TO PROVIDE FOR A REPORT BY THE METROPOLITAN PARK COM-
MISSION UPON THE FURTHER DEVELOPMENT OF THE CHARLES RIVER
BASIN AND EMBANKMENT TO PROVIDE ADEQUATE FACILITIES FOR
PUBLIC RECREATION AND SPORT AND OTHER DESIRABLE USES AND
TO MAKE THE SAME MORE ACCESSIBLE.

Be it enacted, etc., as follows:

1 SECTION 1. The metropolitan park commission is hereby directed
2 to investigate the feasibility and desirability of providing for the
3 further development and utilization of the Charles river basin, in-
4 cluding the embankment and dam, in order to provide adequate
5 facilities for public recreation and sport and such other uses as may
6 appear advisable, by an island or islands within the basin, or some
7 further development of the shores, and by making the same more
8 accessible by an improved approach to the driveway along the east-
9 erly portion of the embankment, and to report in print to this
10 general court, on or before the first day of December, nineteen hun-
11 dred and eleven, the result of such investigations, with such plans
12 and estimates as said commission deems necessary for the purpose.

1 SECTION 2. Said commission may expend out of the metropoli-
2 tan parks maintenance fund a sum not exceeding five thousand dol-
3 lars for the purpose of carrying out the provisions of this act.

1 SECTION 3. This act shall take effect upon its passage.

DRAFT OF OLD COLONY BOULEVARD-HIGHWAY ACT.

AN ACT TO AUTHORIZE THE METROPOLITAN PARK COMMISSION TO ACQUIRE LAND FOR AND TO MAINTAIN A PARKWAY FROM A POINT AT OR NEAR THE CROSSING OF COLUMBIA ROAD AND THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD TO A POINT NEAR NEPONSET BRIDGE IN BOSTON, AND FROM A POINT IN QUINCY NEAR NEPONSET BRIDGE TO LAND HELD BY SAID COMMISSION IN ATLANTIC IN THE CITY OF QUINCY AS AN APPROACH TO QUINCY SHORE RESERVATION.

Be it enacted etc., as follows:

1 SECTION 1. The metropolitan park commission is hereby author-
2 ized to acquire, in fee or otherwise, lands and rights in lands for the
3 purpose of a parkway connection extending from a point at or near
4 the crossing of Columbia road and the New York, New Haven and
5 Hartford railroad location to a point at or near Neponset bridge
6 in Boston, and from a point at or near Neponset bridge in the city
7 of Quincy to land held by said commission at Atlantic in said city of
8 Quincy and forming an approach to Quincy shore reservation. In
9 carrying out the requirements of this act said commission shall, so
10 far as feasible, take such lands and rights in lands, whether in pub-
11 lic or private ownership, as will enable the said commission to pro-
12 vide facilities for highway or street as well as parkway travel and
13 traffic along or in the neighborhood of the route selected by the
14 commission. Between the point where said Columbia road crosses
15 the New York, New Haven and Hartford railroad location and
16 Savin Hill street said commission shall leave opportunity for rail-
17 road connection across the land acquired hereunder by a spur track
18 or tracks from the New York, New Haven and Hartford railroad
19 location to the land on the east of the route selected by the commis-
20 sion; and in the taking by eminent domain of lands hereunder said
21 commission, if it deems desirable, may also make, for the benefit of
22 the owners of said land on the east of said route, exceptions or
23 reservations of the right to construct and maintain spur railroad
24 tracks across the land so taken to and from said land on the east
25 and said New York, New Haven and Hartford railroad location,
26 and said commission may also grant and convey such rights in such
27 cases and on such terms and considerations as it deems wise. For
28 the purposes set forth in this act said commission may exercise all
29 the powers conferred upon it by chapter four hundred and seven

30 of the acts of the year eighteen hundred and ninety-three, chapter
 31 two hundred and eighty-eight of the acts of the year eighteen hun-
 32 dred and ninety-four and all other acts in addition thereto or in
 33 amendment thereof, and may expend the sum of dol-
 34 lars.

1 SECTION 2. To meet the expenditures made under authority of
 2 this act, the treasurer and receiver-general, with the approval of
 3 the governor and council, shall issue scrip or certificates of indebt-
 4 edness, bearing interest at a rate not exceeding four per cent. per
 5 annum, to the said amount of dollars, as an addition
 6 to the Metropolitan Parks Loan, Series Two, at such times and in
 7 such sums as the said commission shall certify to him to be neces-
 8 sary to meet the liabilities incurred by said commission under this
 9 act, and shall add to the existing sinking fund to provide for
 10 the payment of the same. Such scrip or certificates of indebted-
 11 ness shall be issued and additions to said sinking fund shall be
 12 assessed and collected in accordance with the provisions of sections
 13 eight, ten and eleven of said chapter two hundred and eighty-eight,
 14 and in accordance with the provisions of chapter two hundred and
 15 eighty-three of the acts of the year eighteen hundred and ninety-five
 16 and of chapter four hundred and nineteen of the acts of the year
 17 eighteen hundred and ninety-nine.

1 SECTION 3. This act shall take effect upon its passage.

DRAFT OF CAMBRIDGE-SOMERVILLE BOULEVARD-HIGH-
WAY ACT.

AN ACT TO AUTHORIZE THE METROPOLITAN PARK COMMISSION TO ACQUIRE, CONSTRUCT AND MAINTAIN A PARKWAY AND TRAFFIC ROAD CONNECTION BETWEEN WELLINGTON BRIDGE IN THE CITY OF SOMERVILLE AND A POINT ON MASSACHUSETTS AVENUE IN THE CITY OF CAMBRIDGE IN THE VICINITY OF HARVARD BRIDGE.

Be it enacted, etc., as follows:

1 SECTION 1. The metropolitan park commission is hereby author-
2 ized to acquire, in fee or otherwise, lands and rights in lands for,
3 and to construct and maintain, a parkway and traffic road connec-
4 tion extending from a point at or near Wellington bridge in Somer-
5 ville to a point on Massachusetts avenue in Cambridge in the vicinity
6 of Harvard bridge. Said connection may be made, if said com-
7 mission shall deem advisable, by the taking, adaptation and im-
8 provement of existing streets and parkways along the route selected
9 by said commission. For the purposes set forth in this act said
10 commission may exercise all the powers conferred upon it by chap-
11 ter four hundred and seven of the acts of the year eighteen hundred
12 and ninety-three, chapter two hundred and eighty-eight of the acts
13 of the year eighteen hundred and ninety-four, and all other acts in
14 addition thereto or in amendment thereof, and may expend the sum
15 of dollars.

1 SECTION 2. To meet the expenditures made under authority of
2 this act, the treasurer and receiver-general, with the approval of the
3 governor and council, shall issue scrip or certificates of indebtedness,
4 bearing interest at a rate not exceeding four per cent per annum,
5 to the said amount of dollars, as an addition to the
6 Metropolitan Parks Loan, Series Two, at such times and in such
7 sums as the said commission shall certify to him to be necessary to
8 meet the liabilities incurred by said commission under this act,
9 and shall add to the existing sinking fund to provide for the
10 payment of the same. Such scrip or certificates of indebtedness
11 shall be issued and additions to said sinking fund shall be assessed
12 and collected in accordance with the provisions of sections eight,
13 ten and eleven of said chapter two hundred and eighty-eight, and
14 in accordance with the provisions of chapter two hundred and
15 eighty-three of the acts of the year eighteen hundred and ninety-five
16 and of chapter four hundred and nineteen of the acts of the year
17 eighteen hundred and ninety-nine.

1 SECTION 3. This act shall take effect upon its passage.

REPORT ON CONNECTION BETWEEN LOWELL STREET
AND CAUSEWAY STREET.

DECEMBER 16, 1910.

Hon. GEORGE G. CROCKER, *Chairman, Joint Board on Metropolitan Improvements, 14 Beacon Street, Boston, Mass.*

DEAR SIR:—Following your instructions, I have studied the problem of an adequate traffic road connection between the Charles River dam and the main thoroughfares of the city. Such a connection can be made most conveniently by following Lowell Street (at its present width of 60 feet) to Minot Street, and thence by a short and favorable diagonal of 500 feet, largely under the proposed tracks of the Boston Elevated Railroad, to Leverett Street. Upon this line a street of 71 feet 6 inches width (shown in Scheme No. 1 and Section No. 1) could be provided under and adjoining the Elevated structure, without radically disturbing the locations already planned for its supports. By relocating six of these cross-girders, however, a 60-foot street (shown in Scheme No. 2, Section No. 2, and requiring the taking of 2,000 square feet less land) could be provided, which would comfortably accommodate four lines of heavy street traffic, including two lines of electric cars and two lines of 10-foot sidewalk. The positions of the elevated structure supports required by this narrower scheme would be evidently more favorable to the use of the street for vehicular traffic than those of the wider project.

Sheet No. 3 shows the relations of both schemes to the property lines of the vicinity and to the latest plans of the Boston Elevated Railway Company. The accompanying table of land areas and assessed valuations clearly indicates other conditions of the two solutions of the problem.

Very truly yours,

ARTHUR A. SHURTLEFF.

NOTE.—The land areas and assessed valuations given in the tables submitted by Mr. Shurtleff, when summarized, are as follows:—

<i>For 60-foot Roadway.</i>					Sq. Ft.
Area of Boston Elevated land to be used, . . . . .	.	.	.	.	16,428
Area of private land to be acquired,	2,990
Total,					19,418
Assessed value of private lands and buildings,	\$52,557



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— — — — —

<i>For 71.5-foot Roadway.</i>						Sq. Ft.
Area of Boston Elevated land to be used,	18,686
Area of private land to be used,	3,563
Total, .						<hr/> 22,149
Assessed value of private land and buildings, .	.	.	.	.	.	\$58,819

PLAN FOR THE EXTENSION OF NORTHERN AVENUE, BOSTON, ESTABLISHING A NEW TRAFFIC THOROUGHFARE AND A LOCATION FOR A TUNNEL BETWEEN THE NORTH AND SOUTH TERMINALS.

REVISED ESTIMATES BY LESLIE C. WEAD, NOVEMBER, 1910, SUPPLEMENTAL TO REPORTS DATED SEPT. 13, 1909, AND NOV. 3, 1909.

In former reports the areas and assessed values were taken from the valuations of 1908. In the valuations for 1910 some changes have been made, both in areas and in valuations. Some changes have also been made in the estimates of the areas included in the new street lines. This accounts for the difference between the figures here used and those used in former reports.

The questions now submitted are: what would be the land damages for the taking of sufficient areas, first, to construct the road under existing law, which allows the taking of remnants of estates portions of which only are required, "if the remnant left after taking such part would from its size or shape be unsuitable for the erection of suitable and appropriate buildings, and if public convenience and necessity require such taking;" and second, if the taking should include also such estates as would be advisable for use in connection with remnants to secure a proper development of the property abutting on the new thoroughfare.

A tabulation of all the estates affected, portions of which are required for the thoroughfare, shows a total of 158 estates, having an area of 405,900 square feet, assessed for \$5,703,600, with buildings assessed for \$2,205,000, making a total assessed value of \$7,908,600; that is, the land is assessed for an average of \$14.05 per square foot, against the former estimate of \$13.69, — an increase of \$0.36 a foot; the buildings for \$5.43, as compared with \$5.42 in 1908; making a total average assessment of \$19.48, as compared with \$19.11 per foot in 1908, being an increase of \$0.37 per square foot.

In the former estimates it was assumed that these properties could be purchased for 25 per cent. in excess of the assessor's valuations; and,

while it might be impossible to purchase some of the estates at this figure, it is believed that the majority cost would be covered by the sum, provided the entire estate should be taken in and the assessment on the correctness of this basis, the total cost of all the estates affected, as assessed for \$7,408,600, would be \$6,867,700. The remainder of these estates, as closely as they could be estimated from the value of the would amount to about 14,474 square feet. The average value of these remnants, as formerly estimated, was \$21 per foot, amounting to the buildings. Since that time the assessors have determined the unit value \$6.66 per foot and it will probably be safe to assume that the average value of these remnants would be \$21 per foot, amounting to \$4,539,550, leaving the net cost of the land to be paid for in some \$5,048,650.

In the foregoing estimate it has been assumed that all the portions of value would be retained for the new street, which is under the provisions of chapter 461 of the Acts of 1914. It seems probable that some of these, from which only a small amount of value might be obtained, might not meet the condition of the statute, which requires that the value be at least 25 per cent of the assessed value.

A further table of the properties taken under the new statute, at the cost of taking up such portions of the land as would be taken, shows the remnants would be large enough to be estimated for themselves. In these estimates a much larger value was taken than 25 per cent of 60 per cent of the assessed value. This assumption, however, was deemed a safe one where the entire estate would be taken. The same properties would be offered as in the schedule of properties mentioned, having a total area of 407,400 feet, and having an assessed value of \$7,408,600. The area retained for the street would be 212,426 square feet. The remnants which might be considered to be taken under the provisions of the statute would amount to 48,174 feet, and those which would be left in hands of present owners would amount to 147,200 square feet. From the table of value referred to in the several publications, it appears that the total cost of the land to be taken, including 48,174 feet of remnants, would be \$6,177,450, with the addition of the remnants \$1,190,250, leaving a net cost of the land to be paid for the streets under this plan of \$7,277,600.

The second question as to the total cost of the land to be taken for the new street, and to see how it compares with the proper development of the city, comes planning on the new street project, and does not concern the probable values of large areas of land. It is the mind to be used for the new street project itself. It is assumed that passage by the Legislature of enabling legislation to cover the purchase of the land used, amendment to the Constitution of the State, authorizing the Legislature to pass the required act.

In estimating on the cost of land required for such a taking, the schedule used in the supplemental report of Nov. 3, 1909, has been revised. It would be necessary to take the entire area included in the 158 estates mentioned, in answer to the first question; that is, 405,900 square feet, with the estimated cost of \$9,885,750, and, in addition thereto, 121 estates having an area of 223,664 square feet, assessed for \$2,635,600, and including buildings assessed for \$872,500, making a total assessment of \$3,508,100. Adding 25 per cent. to this valuation, as before, would make the additional cost \$4,385,125, making the total cost of land purchased \$14,270,875.

The total area taken would be 629,564 square feet, with an average estimated cost for land and buildings of \$22.67. Deducting from the total area the amount required for the street (212,426 square feet), there would remain for sale or other disposition 417,138 square feet, which should have an average selling value of not less than \$25 per square foot, amounting to \$10,428,450. Deducting this from the total estimated cost (\$14,270,875) would leave as the net cost of land required for the street \$3,842,425.

In the foregoing estimates no account has been made of the question of interest on the cost of land to be taken, nor of the probable requirements for providing streets to afford rear entrances to the estates abutting on the new thoroughfare, as discussed in the report of Nov. 3, 1909. Neither has any special account been made of the value of the buildings which would remain on the remnants to be sold after the building of the street, the valuations placed upon these remnants and upon the properties taken for re-sale being approximately sufficient to cover the values of the buildings remaining. It is assumed that the abutting estates would be sufficiently increased in value to make up for any loss of area in consequence of the construction of the proposed additional streets in the rear of the properties fronting on the new thoroughfare. No account is taken in this report of the cost of the widening of Cross Street at the entrance to Haymarket Square or of the short street on the other side between Canal and Merrimac streets, as proposed in the report of Nov. 3, 1909.

The areas taken for the several purposes are indicated on the accompanying blue print, which was made from the plans submitted with the previous reports; the areas to be included in the streets colored *red*, those of the remnants under Plan 2 in *yellow*, those of the additional remnants under Plan 1 in *blue*, and those of the independent estates under Plan 3 in *green*.

The areas and amounts involved in the three plans above described are as follows:—



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PLANS.	Area Taken (Square Feet).	Value.	Area used (Square Feet).	REMNANTS FOR SALE.		Net Cost.
				Area (Square Feet).	Value.	
Second plan: — Taking required areas and remnants not suitable for independent use,	260,700	\$6,507,450	212,426	48,274	\$1,130,150	\$5,377,300
First plan: — Taking entire estates, . . .	405,900	\$9,885,750	212,426	193,474	\$4,836,850	\$5,048,900
Third plan: — Taking adjoining estates to provide suitable areas for development,	223,664	4,385,125	—	223,664	5,591,800	
Totals, third plan,	629,564	\$14,270,875	212,426	417,138	\$10,428,450	\$3,842,425

The schedules from which the foregoing figures are taken will be available for examination if desired.

Respectfully submitted,

LESLIE C. WEAD.

Boston, Nov. 4, 1910.

DRAFT OF ACT TO PROVIDE FOR A SYSTEM OF METROPOLITAN HIGHWAYS.

AN ACT TO PROVIDE FOR AN ADEQUATE AND CONVENIENT SYSTEM OF METROPOLITAN HIGHWAYS.

Be it enacted, etc., as follows:

1 SECTION 1. The board of commissioners, constituted
2 under and by virtue of chapter of the acts of the year
3 , is hereby directed to investigate and study a method
4 of securing an adequate and convenient system of important high-
5 ways in and about Boston by such alterations and extensions of the
6 principal existing highways of the metropolitan district and the
7 creation of such additional highways as might together form such
8 a system. Said board shall prepare a plan indicating the existing
9 highways which in the opinion of said board should be classed as
10 metropolitan highways, and also indicating the lines along which
11 such highways should be extended and new highways created in
12 order to form a complete system of metropolitan highways. Said
13 board shall report in print to the next general court on or before
14 the second Monday in January the result of its investigations and
15 studies and its recommendations in connection therewith, and shall
16 submit with its report said plan of a system of metropolitan high-
17 ways and such other maps, plans and illustrations as said board may
18 deem necessary.

1 SECTION 2. For the purpose of carrying out the requirements of
2 this act said board may employ such engineers and other experts and
3 assistants as it may deem necessary, and may expend a sum not
4 exceeding dollars, to be paid from the treasury of the
5 Commonwealth.

1 SECTION 3. This act shall take effect upon its passage.

DRAFT OF AN ACT TO PROVIDE FOR THE CONSTRUCTION
OF A TUNNEL BETWEEN THE NORTH AND SOUTH
STATIONS.

AN ACT TO PROVIDE FOR THE CONSTRUCTION OF A RAILROAD TUNNEL
THROUGH THE CITY OF BOSTON FOR A CONNECTION BETWEEN THE
TRACKS OF THE BOSTON AND MAINE RAILROAD AND THOSE OF THE
NEW YORK, NEW HAVEN AND HARTFORD RAILROAD COMPANY.

Be it enacted, etc., as follows:

1 SECTION 1. The Boston and Maine railroad and the New York,
2 New Haven and Hartford railroad company, hereinafter called the
3 companies, which term shall be deemed to include their successors
4 and assigns, or either company, as the case may be, but shall not
5 include any construction company, may construct, maintain and op-
6 erate a tunnel for four or more tracks, for the conveyance of pas-
7 sengers and freight between said railroad systems, together with
8 approaches, entrances, connections at grade with the tracks of said
9 companies, stations, elevators, inclines and other appurtenances
10 thereto, such tunnel with its appurtenances being hereinafter called
11 the tunnel.

1 SECTION 2. The expense of the construction, maintenance and
2 operation of said tunnel and the ownership thereof shall be equally
3 divided between said companies, unless they shall otherwise mutually
4 agree, with the approval of the board of railroad commissioners,
5 hereinafter called the board. For the purposes of taxation the tun-
6 nel shall be considered as real estate belonging to the companies
7 within the city of Boston, and, in proportion to their respective
8 net expenditures therefor, shall be assessed to them respectively as
9 of a total value equal to its net cost up to that year as determined
10 by the board.

1 SECTION 3. The route shall be subject to the approval of the
2 members of the board of railroad commissioners and of the Boston
3 transit commission, sitting jointly, and hereinafter called the double
4 commission, and of the mayor of the city of Boston; and the grades,
5 sections and the method of construction shall be subject to the ap-
6 proval of said double commission.

1 SECTION 4. The Boston transit commission shall immediately
 2 after the acceptance of this act make such preliminary investiga-
 3 tions, surveys and plans as it deems necessary, and for this purpose
 4 may, and said companies, with the consent of said Boston transit
 5 commission, may, enter upon any lands so far as is deemed necessary
 6 to make such preliminary investigations, surveys and plans, and
 7 may place and maintain marks, make borings and excavations and
 8 do all other acts necessary therefor. Said Boston transit commis-
 9 sion may expend such sums as it deems necessary therefor, which
 10 shall be paid by said companies and shall be included in and form
 11 a part of the cost of said tunnel.

1 SECTION 5. The companies, before beginning the work of con-
 2 struction, and within two years from the passage of this act, shall
 3 cause to be prepared a plan showing the proposed route and grades
 4 of the tunnel and the general form and method of its construction
 5 and the location of the proposed tracks and connections; and no
 6 work of construction shall be begun until such plan has been ap-
 7 proved by said double commission, and a copy thereof filed in the
 8 office of the engineer of the city of Boston and in the office of the
 9 Boston transit commission. Any such plan may be amended or
 10 altered at any time by a new plan approved by said double com-
 11 mission and filed as aforesaid.

1 SECTION 6. The companies, for the purposes of this act, may
 2 use existing public ways without compensation therefor, and may
 3 take lands, including the buildings thereon, and easements, estates
 4 and rights in land, including the right to go under the surface
 5 thereof, or through or under buildings or parts of buildings thereon;
 6 and such takings in fee, perpetuity or for any less estate, may be
 7 made whether the lands taken or otherwise affected are held under
 8 or by title derived by eminent domain or otherwise; and the taking
 9 or purchase of any easement or other estate or right in a given
 10 parcel of real estate, whether such parcel consists of unimproved
 11 land, or of land and buildings, may be confined to portions or sec-
 12 tions of such parcel fixed by planes or other surfaces of division
 13 below or above or on the level of the ground, and in such case no
 14 taking need be made of other parts or sections thereof, except such
 15 easements therein, if any, as the companies may deem necessary.
 16 Nothing herein contained shall authorize, except by purchase, the
 17 acquisition of property of any other railroad or any street railway
 18 company. No taking of any land or rights therein of the Boston
 19 terminal company, or agreement with said company in relation
 20 thereto, shall be made unless the approval of the board has been
 21 first obtained.

1 SECTION 7. To make any taking by right of eminent domain, the
 2 companies shall cause to be recorded in the registry of deeds in the
 3 county of Suffolk a description of the lands, easements, estates or
 4 rights to be taken, as certain as is required in a common conveyance
 5 of land, with a statement that the same are taken under the authority
 6 and for the purposes of this act, signed by a majority of the direc-
 7 tors of both companies, and the lands, easements, estates or rights so
 8 described shall thereupon be taken for such purposes. The compa-
 9 nies shall, at the same time, give written notice of such taking to
 10 the owner of the property taken, if known; but want of such notice
 11 shall not affect the validity of the taking, nor extend the time for
 12 proceedings for the recovery of damages.

1 SECTION 8. The companies may sell or remove the buildings from
 2 any and all lands purchased or taken, and shall sell, if a sale be
 3 practicable or, if not, shall lease any lands or rights in land or
 4 other property so purchased or taken whenever the same shall, in
 5 the opinion of the double commission, cease to be needed for the
 6 purposes of this act.

1 SECTION 9. The companies shall pay all damages for property,
 2 whether in public or private ownership, taken, injured or used by
 3 them in constructing the tunnel or in doing any work preliminary
 4 thereto or in connection therewith, except that no damages shall be
 5 payable in respect of the use of existing public ways; they may
 6 agree with any owner of such property upon the amount to be paid
 7 as compensation or damages therefor, and if the parties do not
 8 agree, the same may be determined by a jury in the superior court
 9 for the county of Suffolk, on petition of such owner against the
 10 companies, filed in the clerk's office, in the case of a taking within
 11 one year from the time when open entry is made on the property
 12 taken, or in case of injury within one year from the time when that
 13 portion of the work causing the injury is completed; and judgment
 14 shall be entered upon the verdict of such jury, and costs shall be
 15 taxed and execution issued in favor of the prevailing party as in
 16 other civil cases. The provisions of law relating to procedure in
 17 case of damages to estates in which several parties have different
 18 or several interests shall apply to proceedings in such cases under
 19 this act. The companies shall indemnify the city against all liability
 20 for damages arising out of the work herein provided for, upon no-
 21 tice of any claim therefor, and opportunity to defend against the
 22 same.

1 SECTION 10. The Boston transit commission, upon the written
 2 request of the companies, may order the temporary or permanent

3 removal or relocation of any surface tracks, or of any conduits,
 4 pipes, wires, poles or other property of any person or corporation,
 5 which the companies deem to interfere with the construction or
 6 operation of the tunnel, and at the same time shall if desired
 7 grant new locations for any such structures previously having
 8 locations. Such order of removal, to the extent specified therein,
 9 shall be deemed a revocation of the former right or license
 10 to maintain such surface tracks, conduits, wires, pipes, poles
 11 or other property, and the owner of any such structures in
 12 public ways or lands shall comply with such order. If the
 13 owner shall fail to comply with such order within a reason-
 14 able time, to be fixed therein, the companies may remove such
 15 surface tracks, conduits, wires, poles or other property, and may
 16 relocate and reconstruct the same. In either case the cost of such
 17 removal, relocation and reconstruction shall be paid by the compa-
 18 nies. Any gas or electric lighting company shall shut off the gas
 19 or current from any pipes or wires affected by any action done
 20 hereunder when and so far as may be necessary to avoid the escape
 21 or explosion of gas or other public danger. The companies shall
 22 not remove or interfere with the property of the city of Boston or
 23 other public property unless the Boston transit commission certifies
 24 that such action is necessary for the proper conduct of the work;
 25 and in such case the work of removing, altering, relocating and
 26 reconstructing shall be done by the authorized public officials, and
 27 the companies shall pay the cost thereof; or if such officials so elect,
 28 such work may be done by the companies under such supervision
 29 and control as such officials with the approval of the Boston transit
 30 commission may see fit to exercise. In any event such public prop-
 31 erty shall be restored so soon as practicable to a condition as ser-
 32 viceable and durable as it was in before the work was begun. The
 33 companies shall comply with all rules, regulations and ordinances
 34 of the city relating to the obstruction of or excavation in any ways
 35 or public lands so far as the same, in the opinion of the Boston
 36 transit commission, may be consistent with the proper conduct of
 37 the work.

1 SECTION 11. Work done under this act, in or under any public
 2 way in the city, shall be conducted, so far as practicable, in such
 3 manner as to leave such way, or a reasonable part thereof, open for
 4 travel between the hours of seven in the forenoon and six in the
 5 afternoon of each secular day, except public holidays.

1 SECTION 12. Any person or corporation using or authorized to
 2 use wires along the route of the tunnel may place the same therein
 3 in such manner and upon such conditions and terms as to compen-
 4 sation or otherwise as may be agreed upon with the companies and

5 approved by the Boston transit commission, except that no contract
6 therefor shall extend beyond the term of the ownership of said tun-
7 nel by said companies, in case such ownership should be terminated
8 as hereinafter provided. Subject to the approval of such double
9 commission pipes, wires and other property of the city of Boston
10 may be placed and maintained in said tunnel without charge there-
11 for.

1 SECTION 13. Until the tunnel account is closed, the companies
2 shall quarterly render to the double commission a statement showing
3 their expenditures and receipts in connection with the work in such
4 detail, and with such vouchers and copies of contracts and other
5 papers as the double commission may require. The companies shall
6 quarterly pay to the city of Boston such sums as the Boston transit
7 commission may certify to be the proper share of the general ex-
8 penses of said commission on account of services rendered under
9 the provisions of this act.

1 SECTION 14. Upon the completion of the tunnel, and before the
2 same is opened for public use, it shall be examined by the double
3 commission; and if it appears that all laws relating to the construc-
4 tion thereof have been complied with, and that the tunnel is in safe
5 condition for operation by electricity, then the double commission
6 shall give to the companies a certificate to that effect, which shall be
7 filed in the office of the secretary of the commonwealth, and there-
8 upon the companies shall be authorized to open such tunnel for
9 use by electric power.

1 SECTION 15. The companies may from time to time, subject to
2 the approval of the board, in the manner and subject to the require-
3 ments prescribed by law, issue jointly or severally and dispose of
4 such additional amounts of their capital stock or bonds, or of either,
5 at their option, as may be necessary to defray the expenditures in-
6 curred by the companies under the authority of this act.

1 SECTION 16. In respect to the equipment, use and operation of
2 the tunnel and transportation therein, the companies severally shall
3 have the rights, privileges and immunities, and be subject to the
4 duties, liabilities and restrictions set forth in the general or special
5 laws now or hereafter in force applicable to them respectively.

1 SECTION 17. At any time after the expiration of twenty years
2 from the opening for use of said tunnel, or by agreement with the
3 companies at an earlier time, and upon the payment to the compa-
4 nies by the commonwealth of Massachusetts of such amounts as will
5 reimburse to the companies the original net cost of said tunnel,

6 which shall not include rolling stock, but shall include interest at
 7 three per cent. each year on sums expended for construction from
 8 the time of expenditure to the time of the opening for use, together
 9 with simple interest at six per cent. each year on said net cost from
 10 the opening for use to the date of purchase, deducting, however,
 11 dividends and interest paid after such opening for use upon stock
 12 or bonds issued to meet the net cost as above but without interest
 13 thereon, and also deducting any amounts received from the sale or
 14 rental of property acquired for such tunnel as provided in this act,
 15 the title to such tunnel, and all rights and interests therein, shall
 16 vest exclusively in the commonwealth, and thereafter such tunnel
 17 may be leased to one or more railroad corporations organized under
 18 the laws of the commonwealth for such term as the board may
 19 determine, at a rental equal to four and one-half per cent. on the
 20 purchase price, the other provisions of the lease being such as the
 21 board may deem reasonable. This right of acquisition shall be in
 22 addition and subject to the rights of the commonwealth under gen-
 23 eral laws.

1 SECTION 18. The supreme judicial or the superior court, upon
 2 application of the companies or any other party in interest, may by
 3 any appropriate process enforce, or prevent violation of, the pro-
 4 visions of this act.

1 SECTION 19. This act shall take effect, if accepted by the com-
 2 panies, within one year from its passage, and when so accepted it
 3 shall be the duty of the companies to proceed with diligence in pre-
 4 paring for and carrying on the work of construction, to the end that
 5 the tunnel may be opened for use within five years from the date of
 6 the approval of the original plan required by section five. If the
 7 construction herein provided for is delayed by litigation, unforeseen
 8 casualty or other cause, the companies may apply to the board
 9 for extension of the time therefor; and the board, upon such notice
 10 as it may deem necessary and upon hearing thereon, may determine
 11 what extension of time may reasonably be allowed for the comple-
 12 tion of said construction, and such further time shall thereupon be
 13 allowed therefor.

REPORT OF THE NEW YORK, NEW HAVEN & HARTFORD
AND THE BOSTON & MAINE RAILROADS ON ELEC-
TRIFICATION.

THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY,
PRESIDENT'S OFFICE, NEW HAVEN, CONN.,
AT BOSTON, MASS., NOV. 1, 1910.

*To the Honorable Joint Board on Metropolitan Improvements, 14 Beacon
Street, Boston, Mass.*

GENTLEMEN:—I beg to submit herewith the report of Vice-President McHenry, who has had charge of electrification matters upon the New Haven Road for several years back, regarding the electrification of the railroad corporations controlled directly and indirectly by the New York, New Haven & Hartford Railroad Company within the Metropolitan District, so-called, in accordance with the Resolves of the General Court of the State of Massachusetts, under the terms of chapter 134 of the year 1910.

Yours truly,

C. S. MELLEN,
President.

THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY,
OFFICE OF VICE-PRESIDENT, NEW HAVEN, CONN., OCT. 31, 1910.

Mr. C. S. MELLEN, *President.*

DEAR SIR:—The following report and estimates are submitted, which have been prepared in compliance with the terms of chapter 134 of the Resolves of the Legislature of the State of Massachusetts, which provides that the railroad corporations operating within the Metropolitan District "... be directed to prosecute studies with reference to the electrification of their passenger service in said district, and to present the result of such studies on or before the first day of November to the Joint Board on Metropolitan Improvements."

It was quite impossible to devote the proper degree of study and investigation to this subject within the very brief time set by the Legislature, which the magnitude and complexity of the problem demand; but a special effort has been made to present at least the salient features of the proposed electrification of railroads within the Metropolitan District, together with an approximate estimate of the cost, in order to comply as fully as possible with the terms of the resolves of the last Legislature.

The investigation of the traffic conditions of the New York, New Haven & Hartford and the Boston & Maine railroads has been completed by Mr. A. B. Corthell, consulting engineer, to whom the task was assigned, which included a study of the train service upon some twenty through lines and branch lines, together with analyses of the number and direction of trains operated, train schedules, tonnage, speed and terminal conditions.

To Mr. W. S. Murray, electrical engineer, was assigned the task of analyzing the traffic data and the preparation of estimates of the cost of the necessary power houses, overload equipment, tracks, and of the electric engines and multiple unit equipment required to replace the present steam engines and passenger cars.

The results of these investigations are substantially comprised in various maps, diagrams and charts appended to this report, as follows: —

A map showing in heavy lines the portions of the railroads included within the proposed electric zone, also the number of tracks and the number of trains operated over same within twenty-four hours, as compiled from the summer time table of 1910.

Diagram 1 shows the number of trains in and out of the North and South Stations each half hour, and illustrates the relative amount of traffic in each direction at different hours of the day.

As a matter of interest, the number of passengers in and out of the two stations, together with similar data for the Grand Central Station at New York for the past ten years, is added.

The curve of future growth may be approximated by extending the curves on this diagram.

Diagram 2 shows curves of train weights, including motors, moving each period of ten minutes throughout the day of twenty-four hours on the New York, New Haven & Hartford Railroad for each district, and a curve of totals for all districts within the electric zone.

Diagram 3 shows similar data for the Boston & Maine Railroad for each division, and totals for all divisions within the electric zone.

Diagram 4 shows the combined totals for both the New York, New Haven & Hartford Railroad and the Boston & Maine Railroad, also the train weights upon which the estimated power-house requirements are based.

Equipment estimates showing the amount of electrical equipment necessary to cover the service between Boston and the suburban terminals. These estimates show both the number of electric engines required to perform all service, or, as an alternative, the number of electric engines required for the operation of through trains only, and the number of motor and trailer cars operating in multiple unit service required to replace the present trains terminating within the electric zone.

A statement showing the number of steam and electric engines or equivalent multiple unit cars at all suburban termini, for which it is necessary to provide electric or steam engine facilities, also the capacity of the facilities now in existence at each point, together with estimates of cost.

A supplementary diagram, showing the average daily runs and energy in k. w. hours required for the motors in local and express service for both the New Haven and Boston & Maine trains. This diagram is accompanied by a blue print showing the proposed Boston electric zone, upon which is marked the general routes and track systems of both the New Haven and Boston & Maine railroads, also showing location and distances of main line and yard tracks.

Condensed estimates of construction cost within the Metropolitan District of Boston.

It is not believed that the maps, charts and statements as above require an extended commentary, as they are practically self-explanatory. The estimates of construction cost are based upon the single phase system of electric operation as adopted in service between Woodlawn and Stamford on the New York division of the New York, New Haven & Hartford Railroad.

This system employs a generating voltage of 11,000 volts, with a frequency of 25 cycles. An installation of this kind, as proposed for the lines in the vicinity of Boston, will differ, however, in some very important particulars, as the complications and increased cost due to the dual operation of both the single-phase system of the New Haven Company and of the direct-current system of the New York Central Company will be avoided.

No substations will be required within the zone of electrification, and, as all current will be taken from an overhead contact, no third rail for conducting current to engine shoes will be required. The elimination of the third rail is particularly desirable in this instance, as its introduction would create grave difficulties in working out plans for the equipment of the many and complicated track systems in terminal yards and at cross-overs.

The estimates for main lines, sidings and yards have been considered upon passenger basis only, and do not cover freight and switching service.

The power requirements have been ascertained by applying to the computed ton mileage an average coefficient derived from the experience of the New Haven Company on its New York division from operation within its electric zone, which affords an estimate of the amount of energy required, expressed in terms of k. w. hours.

This result has been equated by adding 50 per cent. for holiday conditions, 15 per cent. to include heating and lighting of local trains by electricity, and 25 per cent. to cover transmission losses and power used for general auxiliaries, station and yard lighting, signaling, shop and other power requirements.

The estimate so obtained has been reduced by applying the two-hour overload capacity of generators, with the final result that a normal generating capacity of 60,000 k. w. is indicated as required.

The estimates for transmission lines and the overhead contact system

cover the equipment of single and multiple main track mileage and trackage in terminals, yards and sidings, as follows:—

15.46 miles,	. . . . .	four-track routes.
128.07 miles,	. . . . .	double-track routes.
32.44 miles,	. . . . .	single-track routes.
111.20 miles,	. . . . .	yard tracks and sidings.

The total mileage included in the above estimates is equivalent to 461.62 miles of single track.

The construction types of the overhead structures and suspended system will be quite similar to those installed on the New York division of the New Haven Company, subject to certain modifications and improvements which our experience indicates should be made.

The necessity of changing from steam to electricity and *vice versa* at the limits of the electric zone makes it necessary to provide proper transfer facilities, for which due provision has been made in the estimate.

It will be noted that this is a very burdensome requirement, both in its effect upon construction cost and operating expenses.

The equipment estimates attached to this report indicate that equipment must be provided for the operation of 14,630 daily train miles, based upon the summer schedule of 1910. This is the theoretical or time table mileage, as compared with the total actual mileage, including deadheading and helping, of 17,286 miles.

The electric locomotives and multiple unit equipment required to replace the present equipment in this service as given in the estimate include additions of 15 per cent. for shopping reserve and 50 per cent. for holiday service and contingencies.

The estimates for heavy repair shops and spare parts require no explanation.

The estimates for the complete equipment of the New Haven and Boston & Maine railroads, as shown in greater detail in the attached summaries, amount to \$13,862,750 and \$18,889,192, respectively, or \$32,751,942 total for both companies.

It will be understood that these estimates are based upon a plan for electrification within the Metropolitan District of Boston in literal compliance with the request of the Legislature, which in no wise represents the scope and method of development which would naturally be favored by the railroad companies in interest. The proposed restriction of the operation to the Metropolitan District establishes limits which are purely artificial and arbitrary, having but little relation to the flow and volume of traffic, and makes necessary the establishment of costly intermediate terminals at some thirteen points on the district boundaries for accommodating both steam and electric motors.

All trains passing through these transfer points will be subject to delays of three or four minutes in both directions; and accordingly the improved

service within the Metropolitan zone will be gained only by sacrificing the commercial interests of many important secondary centers and outlying points, such as Marblehead, Salem, Lawrence, Lowell, South Framingham, Walpole, Brockton, Whitman and Greenbush, which communities will be less well served than at the present time.

Similar conditions forced the extension of electric service on the New York division of the New Haven Company to Stamford, and on the New York Central lines to White Plains and Yonkers, although not required by the Act of the Legislature, as such further extensions were necessary in order to avoid the cost and delays incident to engine transfers within suburban limits.

These conditions lead to the conclusion that the subject requires a more complete and comprehensive study, before fixing limits for the proposed electric service.

The problem in its general nature is altogether different from the conditions at New York, as in the latter case the entire traffic of the New York, New Haven & Hartford and New York Central railroad companies within the city limits is concentrated upon a single four-track route between the Grand Central Terminal and Woodlawn; while, on the contrary, at Boston the suburban business is diffused over a great area, requiring the equipment for electric operation of not less than twenty through routes and branches, with a corresponding effect upon first cost and operating charges.

Notwithstanding the more favorable conditions at New York, incident to the greater density of traffic and the simpler track system in the region served by the New Haven and New York Central railroads, the records of the New Haven Company demonstrate that under present conditions the electric train service not only fails to earn any interest upon the very large amount of capital invested, but that it has also increased the cost of operation; and, with the less favorable conditions in the vicinity of Boston, it is impossible to escape the conclusion that the deficit in fixed charges and operating expenses will be still greater.

In explanation of this disappointing result, it may be stated that the experience of the New Haven Company in operating a mixed steam and electric service has proven very unsatisfactory. The annoyances and losses due to smoke, cinders, steam and noise are at best only alleviated, without being eliminated, while at the same time so large a proportion of the expense of both methods of operation is retained as to prevent the realization of the fullest degree of economy of either system. This becomes more apparent when it is considered that the power stations, if provided for passenger requirements only, will have a large unused capacity between the hours of peak load, which otherwise could be utilized to very good advantage for the transportation of freight; and more particularly as the occupation of tracks by passenger trains during the hours of peak load acts automatically to limit the simultaneous operation of freight trains at such times. Thus little or no additional investment in

power houses is required for freight operation, and similarly the overhead track equipment serves equally well for both passenger and freight traffic; which makes it practicable to extend electric operation to include all classes of service at the cost of only the additional engines and the equipment of yard trackage required for freight service.

It therefore seems quite safe to conclude that no general substitution of electric for steam traction should be made unless the substitution is complete, including passenger and freight operation and yard switching in addition; and also that in making such substitution the operation should be extended to include the full length of run or engine district, in order to avoid the uneconomical subdivision of the present "train runs," together with the added expense and delays incident to intermediate engine transfer stations.

The extension of the estimates, as given above, to include the very much larger expenditures required to cover the inclusion of freight service and yard switching, together with the probable enlargement of the limits of the electric zone, is not possible at this time, as the data for such estimates are not at present available, but it is certain that the revised and completed totals will be of the most imposing magnitude.

The electrification of the Boston suburban district would release a large number of steam engines and passenger coaches, which should properly be credited to the construction estimate; but, as there is no apparent opportunity for the utilization of so large an amount of equipment of this special type, and as its value for re-sale would be so doubtful, it is not practicable to assign values to this item.

It should also be noted that no account has been taken of the profound changes affecting terminal conditions and methods of operation, which would be introduced if the proposed connection between the North and South Stations at Boston is constructed; and, if there is any reasonable probability of such construction being undertaken in the near future, the installation of an elaborate and costly electric system at the present terminals could not be reasonably considered.

In general, it would seem altogether more practicable to at first restrict the substitution of electricity for steam to a few of the more important routes, subsequently extending the system as rapidly as consistent with the financial conditions and the public needs.

Respectfully submitted,

E. H. McHENRY,
Vice-President.

NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

EQUIPMENT ESTIMATE.

Statement showing the Amount of Electric Equipment necessary to cover the Service between Boston, Campello, Cohasset, South Braintree, Readville, Dedham, Mattapan and Needham Junction, and the Number of Steam Locomotives which can be released; also, the Number of Coaches, by the Use of Multiple Unit Equipment.

Number of electric engines required to perform all service,	64
Time-table miles,	6,777.63
Total mileage, including deadheading and helping,	7,431.88
Number of electric engines required to run trains coming from and going to points beyond electric zone,	40
Time-table miles,	3,956.56
Total mileage, including deadheading,	4,737.76
Multiple unit equipment required to perform balance of service: —	
Motors,	58
Trailers,	67
Time-table miles,	2,821.07
Car miles made by motors,	3,978.00
Car miles made by trailers,	6,430.00
Number of steam engines which can be released,	53
Number of coaches released under this proposition,	164

BOSTON & MAINE RAILROAD.

EQUIPMENT ESTIMATE.

Statement showing the Amount of Electric Equipment necessary to cover the Service between Boston, Swampscott, Wakefield Junction, Wilmington, Lexington, Wayland and Waltham, and the Number of Steam Locomotives which can be released; also, the Number of Coaches, by the Use of Multiple Unit Equipment.

Passenger service: —	
Number of locomotives required,	98
Number of steam locomotives which can be released by substitution of electric locomotives,	35
Number of electric locomotives required for switching service at passenger terminal,	17
Switching engines released at passenger terminal by reason of electrification,	17
Time-table engine mileage,	7,853
Total engine mileage, including deadheading and helping,	9,854

Multiple unit equipment: —

Number of electric engines required to run trains coming from and going to points beyond electric zone,	54
Time-table engine mileage,	4,792
Total mileage, including deadheading,	5,370
Multiple unit equipment required to perform the service entirely within electric zone: —	

Number of motors and trailers, assuming that one motor
car will handle 3 trailers, seating capacity 75 each, 227

Time-table mileage,	2,715
Car miles made by motor cars,	2,715
Car miles made by trailers,	8,145
Number of steam engines which can be released under multiple unit system,	31
Number of coaches which can be released under multiple unit system,	227

TABLE I. — *Showing Steam and Electric Locomotive and Multiple Unit
Stalls required in Metropolitan Electrification District.*

	Steam Engine Stalls with Electrifi- cation.	Electric Locomo- tive Stalls.	Multiple Unit Stalls.	Steam Engine Stalls now in Use.	Cost.
Boston,	—	11	12	47	\$69,000
Campello,	6	5	2	2	45,000
Cohasset,	2	4	13	6	51,000
South Braintree,	2	6	8	5	42,000
Readville,	22	13	6	3	171,000
Dedham,	—	—	6	11	18,000
Mattapan,	—	—	12	5	36,000
Needham Junction,	2	1	—	3	3,000
Boston,	—	32	30	96	186,000
Swampscott,	25	5	15	—	210,000
Wakefield,	25	7	18	—	225,000
Wilmington,	6	5	25	4	102,000
Lexington,	1	3	15	2	54,000
Waltham,	18	8	29	9	165,000
Wayland,	2	3	8	1	39,000
Total cost,					\$1,417,000

**SUMMATED COSTS OF BOSTON METROPOLITAN ELECTRIFICATION DISTRICT,
NEW YORK, NEW HAVEN & HARTFORD RAILROAD.**

(1) Power house (27,500 k. w. (based on average peak),	\$2,750,000 00
(2) Transmission lines and overhead contact system: —	
13.43 miles four-track, at \$40,000	
per mile,	\$536,000
52.58 miles two-track, at \$20,000	
per mile,	1,051,600
17.71 miles one-track, at \$7,000	
per mile,	123,970
61.14 miles yard track, at \$4,000	
per mile,	244,560
	<hr/>
	1,956,130 00
(3) Suburban terminal shops and inspection facilities, .	435,000 00
(4) Heavy repair shops (based on percentage of equip- ment),	172,000 00
(5) Electric locomotives : —	
Light passenger type, 48, at	
\$40,000 each,	\$1,920,000
Heavy passenger type, 21, at \$45,- 000 each,	945,000
	<hr/>
	2,865,000 00
(6) Spare parts for electric locomotives (based on 5 per cent. of Item 5),	143,250 00
(7) Multiple unit motor cars: —	
100, at \$30,000 each,	3,000,000 00
(8) Multiple unit train cars: —	
116, at \$13,300 each,	1,542,800 00
(9) Spare parts for multiple unit cars (based on 2½ per cent. of Items 7, 8),	113,570 00
(10) Signalling (automatic block),	885,000 00
	<hr/>
	\$13,862,750 00

**SUMMATED COSTS OF BOSTON METROPOLITAN ELECTRIFICATION DISTRICT,
BOSTON & MAINE RAILROAD.**

(1) Power house (32,500 k. w.) (based on average peak),	\$3,250,000 00
(2) Transmission lines and overhead contact system: —	
2.03 miles four-track, at \$40,000	
per mile,	\$81,200
75.49 miles two-track, at \$20,000	
per mile,	1,509,800
14.73 miles one-track, at \$7,000	
per mile,	103,110
50.06 miles yard track, at \$4,000	
per mile,	200,000
	<hr/>
	1,894,110 00

(3) Suburban terminal shops and inspection facilities, .	\$982,000 00
(4) Heavy repair shops (based on percentage of equipment),	228,000 00
(5) Electric locomotives: —	
Light passenger type, 65, at \$40,-	
000 each,	\$2,600,000
Heavy passenger type, 28, at \$45,-	
000 each,	1,260,000
	<hr/>
	3,860,000 00
(6) Spare parts for electric locomotives (based on 5 per cent. of Item 5),	193,000 00
(7) Multiple unit motor cars: —	
132, at \$30,000 each,	3,960,000 00
(8) Multiple unit trail cars: —	
261, at \$13,300 each,	3,471,300 00
(9) Spare parts for multiple unit cars (based on 2½ per cent. of Items 7, 8),	185,782 00
(10) Signalling (automatic block),	865,000 00
	<hr/>
	\$18,889,192 00

APPENDIX. — SUMMATED COSTS OF BOSTON METROPOLITAN ELECTRIFICATION DISTRICT.

(1) Power house,	\$6,000,000 00
(2) Transmission lines and overhead contact system, .	3,850,240 00
(3) Suburban terminal shops and inspection facilities, .	1,417,000 00
(4) Heavy repair shops,	400,000 00
(5) Electric locomotives,	6,725,000 00
(6) Spare parts for electric locomotives,	336,250 00
(7) Multiple unit motor cars,	6,960,000 00
(8) Multiple unit trail cars,	5,014,100 00
(9) Spare parts for multiple unit cars,	299,352 00
(10) Signalling,	1,750,000 00
	<hr/>
	\$32,751,942 00



REPORT OF THE BOSTON & ALBANY RAILROAD ON ELECTRIFICATION.

BOSTON & ALBANY RAILROAD (NEW YORK CENTRAL & HUDSON RIVER RAILROAD
COMPANY, LESSEE).

NEW YORK, Oct. 31, 1910.

The Joint Board on Metropolitan Improvements, Boston, Mass.

GENTLEMEN:—As directed by chapter 134 of the Resolves of the General Court of the Commonwealth of Massachusetts, I beg to report the results of the studies which have been prosecuted with reference to the electrification of the passenger service of the Boston & Albany Railroad operating within the Metropolitan District of Boston.

District embraced.—There is appended hereto a map, Exhibit A, which illustrates the lines for which the studies have been made, consisting of the four-track main line from a junction with the South Station to South Framingham, and the double-track Highland branch of the Newton circuit.

While the Grand Junction branch, which extends from Cottage Farms to East Boston, is also within the Metropolitan District, it has been excluded from the studies for the present, for the reason that no regular passenger service is performed upon the branch, the only train movements of that character being infrequent special movements for the interchange of special cars between roads, or for an occasional emigrant train in connection with steamship service.

The Newton Lower Falls branch, which is also within the district, is now electrified.

While the resolve does not impose any duty to make studies beyond the metropolitan line, which intersects the Boston & Albany Railroad main line at Lake Crossing, about 16.2 miles from the Boston terminal, it has been necessary, on account of operating and financial conditions, to continue the studies to South Framingham, where a more suitable location is obtainable for engine terminals, and also to avoid the necessity of having engine terminals both at South Framingham and at the metropolitan line. This extension adds about five miles of main line to the studies required.

There has also been embraced in the studies, while not specifically required by the resolve, the electrification of some of the sidings and local freight stations on the main line, between Cottage Farms and Kneeland Street yards. It is assumed that the purpose of these studies is to ascertain the difficulties which will be encountered in the elimination of the noise and smoke from steam locomotives from the densely populated area

of Boston; and the purpose, therefore, would not be accomplished without considering the electrification of the freight engines employed in handling freight upon these particular sidings and yards.

The track mileage involved in the above electrification is substantially as follows: —

	Miles.
Boston to South Framingham, four tracks,	83.60
Highland circuit, two tracks,	19.78
Yards and sidings,	25.00
<hr/>	
Total,	128.38

Particular attention is called to the fact that no studies are submitted for the electrification of the South Terminal. It has been assumed that that company would submit the result of its own studies. The result, however, must be added to the Boston & Albany Railroad report, as the latter company will doubtless have to bear its proportion of the additional capital and operating expenses involved.

Track and Station Changes. — In making studies involving the electrification of the foregoing tracks, it has been deemed wise to assume that certain changes would first be made in the main track and station arrangements: —

(1) By continuing the four tracks from Trinity Place to connection with the South Station, where there are now three tracks.

(2) To arrange the four-track main line for right-hand operation, so that the two southerly tracks will both be operated eastbound, and the two northerly tracks westbound.

As you are aware, the adjacent tracks now operate in opposite directions, having been primarily so arranged for the Newton circuit.

The above rearrangement will place all local trains upon the outside tracks, and the high-speed trains on the inside tracks, and thus make it unnecessary for passengers to alight from trains upon tracks which are under operation, which might be quite undesirable for a material increase in traffic, as well as on account of the numerous electrical appliances which would be introduced in the track structure.

This change in the method of operating the tracks will of course necessitate some changes in the station buildings, platforms, overhead bridges, subways, etc. These changes are so intimately associated with the studies that they cannot be ignored, and, while they might ultimately be made desirable by a large increase in the operation under steam traffic, they would be immediately precipitated by the adoption of electricity, and it is necessary to consider at this time the cost of the work as a part of the general plan.

Electrification System. — Exhibit A also shows the proposed location of the power house and substations consisting of a main power house in Beacon Park yard, with three substations, located near the South Station, near Riverside and near Natick, respectively.

The power station will contain three 7,500 k. w. turbo-generators, producing current at 11,000 volts, three-phase, 25 cycles.

Substations 1 and 2 will contain three 1,500 k. w. rotary convertors and No. 3 three 750 k. w. rotary convertors.

There is appended hereto Exhibit B, showing the power required to operate the existing schedule, and Exhibit C, showing the schedule which would be possible with the above power installation.

In considering a radical change of this character and its consequent large investment, it is indispensable that some provision be made in the original plan to permit of a reasonable assumed expansion in business, to avoid a wasteful reconstruction or revision of the plant to meet such a contingency. It is believed that the assumed increase in the schedule is conservative.

It has been assumed that aerial transmission lines for both high and low tension will be used on the main line from St. Mary's Street to Natick; and the high-tension feeders east of St. Mary's Street will be insulated cables, either fixed in the ground or attached to the walls of the track depression. No high-tension lines will be required upon the Highland circuit.

The working conductor assumed is the under-running protected third rail, similar to that now employed by the New York Central & Hudson River Railroad Company in New York City, using 1,200-volt direct current therein, instead of 600, as heretofore employed, this higher voltage being a more recent development of the art, and more economical than the former practice.

Equipment. — It has been assumed that the circuit trains and the Boston-South Framingham trains would consist of multiple unit motor cars, and that the through trains would be handled between South Framingham and Boston by electric locomotives, substantially similar to those now used by the New York Central & Hudson River Railroad Company in New York City.

The present service will require the following new equipment: —

Electric locomotives,	16
Motor cars,	62
Trailer cars,	31

This new equipment would retire substantially the following steam equipment: 129 steam locomotives; 113 passenger coaches.

Signals. — The present signal system is now controlled by direct electric currents in the track rails. In the adoption of electricity as a means of propulsion it is necessary to substitute alternating currents for signal control, which requires a complete rearrangement and reconstruction of the existing signal system, which, for the district under consideration, will cost approximately \$700,000, which item will appear in a summary exhibit hereafter referred to.

Tidal Basin. — Certain portions of the track between the South Station

and Boylston Street are now occasionally submerged during high tides or violent storms. It will be necessary to eliminate this trouble by larger tidal basins and drainage systems before electrification is undertaken, which work will cost approximately \$60,000.

Costs of Construction. — The estimated costs of the above work and the annual expense resulting therefrom are shown more fully in Exhibit D, appended hereto, which summarizes substantially as follows: —

	Cost.	Annual Expense.
Cost of construction,	\$7,520,300	\$1,172,604
Credit,	1,107,000	633,413
Increase, net,	\$6,413,300	\$539,191

Owing to the limited time at our disposal for the investigation of the matter, this statement must necessarily be regarded as a rough approximation. However, it is believed to be conservative, and should such work be undertaken, it is probable that the final cost would be more than here stated.

Present Gross Revenue. — The gross revenue derived by the Boston & Albany Railroad in the district under consideration for electrification, including return tickets, single-trip tickets, mileage proportion for traffic entering and leaving Boston for points west of South Framingham, is approximately \$1,300,000.

The visible operating expense of affording this service under steam operation at the present time, without any interest whatever upon the large investment for right of way, tracks and structures, is slightly in excess of the gross receipts.

If to this present deficit there be added the above additional annual expense as result of electrification, namely, \$539,191, the net revenue above operating expenses which accrues to the Boston & Albany Railroad as a whole from the business handled in and out of the city of Boston between all points on the road will be practically absorbed, thus leaving no net revenue from such service to meet existing obligations or those which would be created by this new investment.

The solvency of a transportation company is of paramount importance to the public as well as to the railroad. Insolvency necessarily means inefficient service, and inefficient service means inconvenience and commercial and industrial calamity to the public.

It would therefore seem imperative that any act providing for the electrification of steam railroads under such circumstances, empowering the proper board or boards to determine the manner in which such work should be prosecuted, should also empower the board or other properly constituted authorities to permit the railroad companies to assess all passengers and traffic using the facilities with a terminal charge sufficient to bear the financial burdens imposed, with some additional profit to the

operating company for performing the service and assuming the additional responsibilities and liabilities necessarily introduced.

This would seem more consistent and equitable than to impose it upon other cities, villages or rural communities, in local fares or other forms of transportation, which receive no real estate or other benefits from the new form of transportation employed.

The Boston & Albany Railroad has no material source of income except the receipts from transportation afforded the public. If the public elects through legislative mandate to have that service provided through the use of more costly appliances and methods than formerly, the conclusion is inevitable that the public must ultimately pay the cost, and should therefore have full information on the subject in advance.

The case is analogous to the elimination of grade crossings, where the public participates in the immediate costs, and assumes in transportation expenses the carrying charges on the remainder.

This principle of the public interest in the matter is clearly stated in the fourteenth annual report of the Board of Railroad Commissioners of the Commonwealth of Massachusetts, as follows:—

It is a proposition too clear for discussion, that no company can or ought to be asked to furnish the high standard of railway equipment and service that Massachusetts law demands without at the same time being assured of sufficient income from the public to maintain such equipment and service.

I trust it will not be construed as a digression from the duty as defined in the resolve concerning this matter to quote from my report to the Board of Railroad Commissioners upon the same subject, under date of Dec. 8, 1908 (p. 59, Document 14), as follows:—

. . . It would therefore seem wise, before adopting a policy requiring an expenditure which is not only unremunerative, but which would mean a large annual loss, or radical increase in rates, that further investigations should be instituted, to see if some system might be devised to abate the nuisance complained of without jeopardy to the property, or without placing a large burden upon the public. The rapid evolutions which are being made almost annually in electric traction may soon afford a solution; and the prospect of developing the steam locomotive itself is even more promising for the particular service which steam railroads have to perform.

I trust that it may not be considered inappropriate to mention at this time that the Boston & Albany Railroad is more urgently in need of other expenditures to protect its traffic and the best interests of Boston and the Commonwealth of Massachusetts.

As you are aware, large expenditures must be incurred in restoring the facilities at East Boston to maintain the prestige of the Boston port. Other considerable expenditures are required for enlarging warehouses, team yards, assembling yards, the construction of additional main tracks and the providing of numerous appurtenances for the economical and expeditious handling of traffic to afford good service, which we desire to give, and which the public requires to protect their commercial interests; and it would seem desirable to

make investments and issue securities therefor upon a conservative basis, in order that each investment may be self-sustaining, and the integrity of the property maintained.

I trust that I may be pardoned for venturing another suggestion, concerning which your honorable Board is especially informed. In view of any natural disadvantages, both in distance and in topographical location of the port of Boston, as well as a large portion of Massachusetts, as compared with other ports and manufacturing centers, and especially those now being created by competition in the south, middle west and in Canada, it would seem wise to make every improvement and investment with care, with strict regard to utility, in order that good service may be performed with the greatest possible economy, and thus neutralize, if possible, any such natural disadvantages.

In conclusion, I wish to assure you that we are not unmindful of the evil for which complaint is made, and will exert our best efforts to minimize this, and shall continue further investigations looking to an ultimate solution.

Since this report of 1908 was made, the art of electrification has advanced to the extent that 1,200-volt working conductors are now considered permissible, instead of the 600 volts formerly employed. This advance in the art appreciably reduces the cost of future substation construction; and studies are constantly in progress by many railroad companies, manufacturing companies and engineers, to devise further systems and economies which may render the electrification of steam railroads in congested centers a financial possibility, without undue burdens upon the public.

Meanwhile, the Boston & Albany Railroad, acting in good faith under its promises to the Railroad Commission to make efforts to abate the nuisance concerning which complaint had been made, has spent about a third of a million dollars in equipping the suburban operation in the vicinity of Boston with powerful modern suburban locomotives, in order that their work while handling trains might be less laborious. This reduces the need for rapid stoking of the engines and gives the fireman a wider latitude in which to replenish his fires, and greatly reduces the smoke and noise nuisances. We have also been endeavoring to keep these locomotives supplied with a high grade of low volatile coal, in order that the source of the trouble might be further reduced. Efforts to improve the situation will be continued.

The officers of the company located at Boston will be glad to render any assistance possible in furnishing such additional information as you may desire.

Yours respectfully,

A. H. SMITH,
Vice-President and General Manager.



EXHIBIT D. — Estimated Cost of Electrifying the Boston & Albany Railroad.

ITEMS.	Quantity.	Unit.	Cost.	COST PER ANNUM.					Total Annual Cost.
				Interest and Taxes, 6 Per Cent.	DEPRECIATION.		MAINTENANCE.		
					Rate (Per Cent)	Amount.	Unit.	Amount.	
DEBIT.									
Electrical superintendence,	-	-	\$700,000	\$42,000	5.00	\$35,000	-	\$100,000	\$10,000
Signalling,	-	-	-	64,080	2.00	21,000	-	21,000	177,000
Additional roadway maintenance (miles),	128	\$100	1,068,000	33,264	2.35	13,028	4 cents mile	19,760	12,800
Third rail and bonding (miles),	16	34,650	554,400	66,324	2.35	25,977	2½ cents mile	55,150	106,080
Electric locomotives,	62	17,829	1,105,400	20,190	2.35	7,908	2½ cents mile	27,575	66,032
Motor cars,	31	10,851	336,500	111,570	2.48	46,125	-	26,400	147,451
Trailer cars,	-	-	1,359,500	26,790	2.30	11,163	-	15,000	55,673
Power houses and substations,	-	-	446,500	60,000	2.00	20,000	5%	50,000	184,095
Transmission system,	-	-	1,000,000	21,000	5.00	17,500	6%	21,000	32,953
Station and track changes,	-	-	350,000	6,000	-	-	-	-	130,000
New locomotive and electric terminal,	-	-	100,000	-	-	-	-	-	50,500
Contingencies during construction,	-	-	-	-	-	-	-	-	6,000
Cost of operating power house and appliances to third rail, exclusive of above items,	-	-	-	-	-	-	-	-	165,000
Total	-	-	\$7,520,300	-	-	-	-	-	\$1,172,604
CREDIT.									
Signal system replaced,	-	-	-	\$25,740	4.00	\$17,160	\$8.800	\$255,000 ^a	\$53,000
Steam locomotives,	29	- ^b	\$429,000	40,680	2.35	15,933	700	70,100	297,700
Coaches,	113	\$6,000	678,000	-	-	-	-	-	135,713
Saving in road force (doubtful),	-	-	1,107,000	-	-	-	-	-	49,000
Fuel and supplies 494,000 miles saved on steam engines stopping at South Framingham,	-	-	-	-	-	-	-	-	98,000
Total annual saving,	-	-	-	-	-	-	-	-	633,413
Net increase,	-	-	\$6,413,300	-	-	-	-	-	\$539,191

^a One power house and three substations.^b Invoice.^c Including fuel and supplies.

REPORT OF THE BOSTON, REVERE BEACH & LYNN RAIL- ROAD ON ELECTRIFICATION.

BOSTON, REVERE BEACH & LYNN RAILROAD,
PRESIDENT'S OFFICE, BOSTON, Dec. 12, 1910.

*To the Joint Board on Metropolitan Improvements, 14 Beacon Street,
Boston, Mass.*

GENTLEMEN:— Without conceding that the fair interpretation of chapter 134, Resolves of 1910, namely, "Resolve in relation to the Electrification of Railroads in the Metropolitan District," requires the Boston, Revere Beach & Lynn Railroad to prosecute studies with reference to the electrification of their passenger service in said district, since it now is, and always has been, narrow gauge,— it nevertheless, in conformity to the opinion expressed by your Board in correspondence which has taken place between the railroad and the Board, begs to present results of such studies as the language of the resolve construed to include it would seem to require.

REPORT ON ELECTRIFICATION OF THE BOSTON, REVERE BEACH & LYNN RAILROAD UNDER PRESENT CONDITIONS.

Description of Road.

Gauge of track, 3 feet.	Miles.
Length of main line, East Boston to Lynn, double track, . . .	8.8
Length of branch line, double track,	4.4
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Total length of main line and branch line, double track, . . .	13.2
Total length of main line and branch line as single track, . . .	26.4
Length track in yards and sidings, as single track,	4.1
<hr/>	
Total length as single track,	30.5

Rails, 60 pounds to yard.

Cross-ties, 8 feet standard.

Ballast, 18 inches gravel under tie.

Interlocking plant at East Boston, Orient Heights, Battery Junction
and Lynn, electric block signals.

Highway crossings at grade protected by gates, 10

Rolling Stock.

Locomotives,	21
Passenger cars,	96
Gravel and other cars,	18

Ferry Equipment.

Boats, capacity of each, 1,500 people,	4
--	---

Present Maximum Service.

Two trains every ten minutes in and out East Boston Terminal.

Cost of Electrification. — Estimated Cost to Electrify, under Present Conditions, the Boston, Revere Beach & Lynn Railroad.

Utilizing the present cars, gauge of track to be the same as now, 3 feet:—

Power station and equipment,	\$420,000 00
Overhead material and erection,	90,000 00
Bonding tracks,	15,000 00
Motors for 100 cars, at \$3,500, ¹	350,000 00
Controllers, setting up wiring for 100 cars, at \$300,	30,000 00
Brakes,	40,000 00
Engineering and superintendence,	30,000 00
Interest during constructing,	30,000 00
Total,	\$1,005,000 00

The total liability of the road, including stock, bonds

and floating debt, is, \$1,995,000 00

If we add to this the estimated cost of electrifying, 1,005,000 00

We have a total of \$3,000,000 00

which is entitled to a fair return as interest.

At present the stock pays 6 per cent. annually, and the bonds carry 4½ per cent.

The interest on the floating debt varies, but does not exceed 4½ per cent.

As previously stated, the road now gives a service of two trains leaving and arriving at East Boston every ten minutes.

The study which we have given to the problem satisfies us that this service would not be improved by additional trains or economy in oper-

¹ Fifty horse-power 600 V interpole, new type, direct-current motor to fit 3-foot gauge rails, with ample clearance between the motor and the rails; design and price given by the Westinghouse Electric and Manufacturing Company.

ation if it were electrified; therefore neither the road nor the public who use the road would gain by the change.

The language of the resolve does not ask us to consider and study the standardization of the road, or its extension into Essex County and into Boston proper by a tunnel under the harbor. If the road were compelled to be operated by electricity, then the consideration of these questions would undoubtedly arise, and might well lead to a different result.

Respectfully submitted,

MELVIN O. ADAMS,
President.

VALUE OF EXPORTS AND IMPORTS AT BOSTON.

*Value of Exports and Imports at Boston for a Series of Years,
ending June 30.*

YEARS.	Exports.	Imports.
1830	\$2,506,302	\$8,674,976
1840,	4,485,860	16,591,575
1850,	6,953,528	28,659,733
1860,	13,530,770	39,366,560
1870,	14,136,429	47,524,845
1880,	59,238,341	68,503,136
1890,	71,201,944	62,876,666
1895,	85,505,196	66,889,118
1896,	95,851,004	79,179,864
1897,	100,857,281	90,178,419
1898,	117,531,903	51,475,099
1899,	128,037,149	52,097,960
1900,	112,195,555	72,195,939
1901,	143,708,232	61,452,370
1902,	102,404,304	71,921,436
1903,	88,126,444	86,310,586
1904,	89,845,772	80,657,697
1905,	87,804,492	100,317,881
1906,	98,739,647	106,442,077
1907,	100,872,147	124,432,977
1908,	96,051,068	93,678,716
1909,	76,157,568	112,472,595
1910,	70,516,789	129,006,184

VALUE OF EXPORTS AND IMPORTS AT PRINCIPAL PORTS
OF THE UNITED STATES.

*Value of Exports and Imports at the Principal Ports of the United States
for a Series of Years, ending June 30.*

YEARS.	BALTIMORE.		BOSTON.		CHARLESTON, S. C.	
	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.
1897. . .	\$85,692,651	\$11,371,193	\$100,857,281	\$90,178,419	\$10,872,026	\$983,113
1898. . .	118,845,580	8,907,118	117,531,903	51,475,099	11,440,130	1,311,533
1899. . .	107,156,240	9,151,155	128,037,149	52,097,960	8,059,158	997,879
1900. . .	115,530,378	19,045,279	112,195,555	72,195,939	7,151,720	1,124,671
1901. . .	106,239,081	18,899,473	143,708,232	61,452,370	7,084,215	1,477,719
1902. . .	80,532,512	22,825,281	102,404,304	71,921,436	5,857,364	1,590,078
1903. . .	81,704,497	27,803,167	88,126,444	86,310,586	4,620,930	2,297,462
1904. . .	82,836,164	20,345,788	89,845,772	80,657,697	2,330,675	1,685,832
1905. . .	91,215,058	21,181,239	87,804,492	100,317,881	3,358,725	2,478,156
1906. . .	109,925,046	30,084,653	98,739,647	106,442,077	661,285	2,751,482
1907. . .	104,808,952	37,774,305	100,872,147	124,432,977	1,082,466	3,528,553
1908. . .	89,988,505	29,477,101	96,061,068	93,678,716	2,510,965	3,375,997
1909. . .	77,550,658	24,022,324	76,157,558	112,472,595	4,044,237	3,630,796
1910. . .	77,381,507	29,900,618	70,516,789	129,006,184	8,104,821	5,228,053

YEARS.	GALVESTON.		NEW YORK.		NEW ORLEANS.	
	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.
1897. . .	\$58,198,174	\$779,101	\$480,603,580	\$391,679,907	\$101,494,120	\$16,618,727
1898. . .	68,428,621	1,166,180	445,515,794	402,281,050	112,826,681	9,664,457
1899. . .	78,476,681	2,921,366	459,444,217	465,559,650	87,993,277	11,917,659
1900. . .	85,657,524	1,453,545	518,834,471	537,237,282	115,858,764	17,490,811
1901. . .	101,857,300	953,801	529,592,978	527,259,906	152,776,599	20,462,307
1902. . .	96,722,066	969,246	490,361,695	559,930,849	134,486,863	23,763,480
1903. . .	104,121,087	1,511,119	505,829,694	618,705,662	149,072,519	28,890,744
1904. . .	145,316,457	1,847,646	506,808,013	600,171,033	148,595,103	24,036,516
1905. . .	126,182,043	4,992,361	524,726,005	679,629,256	150,936,947	33,932,296
1906. . .	166,317,652	5,018,876	607,160,314	734,350,823	150,479,326	39,464,982
1907. . .	237,308,494	7,029,186	627,949,857	853,696,952	170,562,428	46,046,772
1908. . .	161,352,201	5,693,609	701,062,913	688,215,938	159,455,773	42,785,646
1909. . .	189,464,335	3,355,308	607,239,481	779,308,944	144,981,625	45,712,098
1910. . .	173,178,992	2,488,006	651,986,266	935,990,958	140,376,560	55,712,627

Value of Exports and Imports at the Principal Ports, etc. — Con.

YEARS.	MOBILE.		PHILADELPHIA.		SAN FRANCISCO.	
	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.
1897, . .	\$10,131,342	\$848,129	\$47,305,273	\$48,072,672	\$39,647,606	\$34,375,945
1898, . .	9,584,248	1,124,401	56,244,436	31,419,997	41,223,759	42,821,945
1899, . .	8,902,119	1,590,648	60,950,065	41,222,523	30,214,904	35,746,577
1900, . .	13,206,334	2,883,934	78,406,031	51,866,002	40,368,288	47,869,628
1901, . .	11,837,105	3,006,449	79,354,025	48,043,443	34,596,792	35,161,753
1902, . .	12,503,558	3,714,371	80,383,403	47,750,342	38,183,755	35,102,981
1903, . .	12,621,278	4,169,040	73,531,968	59,995,431	33,502,616	36,454,283
1904, . .	16,884,611	4,311,249	71,393,254	53,890,106	32,547,181	37,542,978
1905, . .	18,075,056	4,251,264	63,278,070	60,180,901	49,924,026	46,675,545
1906, . .	21,724,380	4,851,326	82,564,389	70,801,273	39,915,269	44,433,271
1907, . .	24,468,719	3,950,360	94,832,480	79,869,942	33,026,664	54,094,570
1908, . .	27,983,997	4,538,698	109,261,436	63,432,007	28,000,069	48,251,476
1909, . .	27,369,714	3,768,808	84,286,440	68,884,146	31,669,370	49,998,111
1910, . .	27,526,245	2,843,350	73,266,343	89,253,451	31,180,700	49,370,643

YEARS.	SAVANNAH.		PORTLAND, ME.		NORFOLK AND PORTSMOUTH, VA.		NEWPORT NEWS.	
	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.
1897	\$23,442,727	\$415,906	\$4,106,200	\$577,295	\$18,581,532	\$121,858	\$22,109,575	\$1,169,315
1898	28,938,166	391,634	6,347,176	433,275	13,978,478	201,080	30,287,521	1,066,727
1899	24,029,572	376,154	9,713,447	652,191	13,831,233	206,005	28,177,817	1,432,426
1900	38,251,981	430,040	9,941,884	782,860	13,112,096	251,799	34,758,323	2,896,828
1901	46,738,967	645,067	12,416,793	633,114	10,308,489	593,930	32,567,912	4,090,451
1902	41,525,428	571,682	14,325,018	1,194,899	7,088,335	390,345	33,504,830	4,311,348
1903	54,140,882	1,037,366	16,284,173	2,653,112	8,757,499	597,744	25,508,391	4,298,799
1904	53,770,382	924,061	11,396,683	1,585,836	9,041,794	474,160	16,712,454	2,131,712
1905	62,244,837	1,488,692	13,934,336	1,053,684	7,654,810	801,709	15,773,353	2,154,660
1906	64,839,551	1,503,069	14,685,464	1,232,928	12,027,215	780,231	20,119,334	2,630,317
1907	63,039,824	2,203,867	14,867,172	1,101,308	8,359,445	945,678	14,932,671	2,945,919
1908	61,695,330	2,043,847	11,693,000	1,100,157	12,534,632	1,096,563	8,365,885	1,627,045
1909	50,900,156	2,152,441	8,250,745	1,268,471	9,685,336	1,450,598	7,787,619	1,182,237
1910	63,428,155	3,855,373	5,177,466	1,164,213	8,155,818	1,523,613	5,059,261	1,748,191

REGISTERED TONNAGE OF VESSELS ENTERED AND
CLEARED AT PRINCIPAL PORTS OF THE UNITED
STATES.

*Registered Tonnage of Vessels entered and cleared at the Principal Ports of
the United States for a Series of Years, ending June 30.*

YEARS.	PORTLAND, ME.		NEW YORK.		PHILADELPHIA.	
	Entered.	Cleared.	Entered.	Cleared.	Entered.	Cleared.
1896, . . .	140,354	185,569	6,911,782	6,552,614	1,416,081	1,214,683
1897, . . .	199,550	237,016	7,267,480	6,943,835	1,539,401	1,411,404
1898, . . .	257,539	276,020	7,771,412	7,576,630	1,636,149	1,592,589
1899, . . .	292,808	314,947	7,707,477	7,496,279	1,658,417	1,688,391
1900, . . .	344,082	372,919	8,176,761	7,843,529	1,850,656	1,885,959
1901, . . .	447,288	451,420	8,679,273	8,118,427	1,923,402	2,004,922
1902, . . .	387,671	384,646	8,982,767	8,415,291	1,926,641	1,945,287
1903, . . .	633,519	592,510	9,053,096	8,847,072	1,993,422	1,861,423
1904, . . .	398,119	420,117	9,235,524	8,700,590	1,712,052	1,728,244
1905, . . .	325,763	329,195	9,630,853	9,311,527	1,833,640	1,817,984
1906, . . .	384,050	395,398	10,476,993	9,913,960	2,080,896	2,250,637
1907, . . .	407,214	431,021	11,383,345	10,472,601	2,330,853	2,334,206
1908, . . .	394,307	406,040	12,154,780	11,939,964	2,439,350	2,477,206
1909, . . .	337,240	332,818	12,528,723	11,866,413	2,274,625	2,225,386
1910, . . .	349,849	320,527	13,042,818	12,541,903	2,606,097	2,250,489

YEARS.	BOSTON.		CHARLESTON, S. C.		MOBILE.	
	Entered.	Cleared.	Entered.	Cleared.	Entered.	Cleared.
1896, . . .	1,757,281	1,523,096	49,333	60,264	306,928	308,035
1897, . . .	1,943,582	1,634,120	100,007	72,707	323,695	383,785
1898, . . .	1,910,490	1,661,872	143,563	96,015	312,706	321,226
1899, . . .	2,129,795	1,872,748	122,960	96,265	386,187	403,491
1900, . . .	2,236,066	1,909,121	95,007	52,645	549,198	505,273
1901, . . .	2,497,441	2,240,317	97,007	38,565	544,898	534,402
1902, . . .	2,411,230	2,087,555	118,739	53,171	496,539	488,120
1903, . . .	2,978,913	2,217,543	152,562	74,790	447,141	514,613
1904, . . .	2,713,371	2,250,977	78,339	16,514	587,104	595,748
1905, . . .	2,604,579	2,082,814	110,763	19,378	611,679	604,653
1906, . . .	2,958,155	2,243,332	112,498	8,592	774,887	726,772
1907, . . .	3,018,888	2,244,124	155,232	34,433	626,297	644,496
1908, . . .	2,864,912	2,075,743	162,330	35,002	644,716	672,174
1909, . . .	2,852,016	1,981,812	176,082	48,352	608,129	666,384
1910, . . .	2,714,382	1,827,887	252,284	59,762	670,990	692,973

Registered Tonnage of Vessels entered and cleared, etc. — Con.

YEARS.	BALTIMORE.		NEW ORLEANS.		SAN FRANCISCO.	
	Entered.	Cleared.	Entered.	Cleared.	Entered.	Cleared.
1896, . . .	895,093	1,067,543	1,071,475	1,077,331	1,221,136	1,165,779
1897, . . .	1,253,072	1,519,397	1,396,261	1,319,716	1,259,653	1,186,618
1898, . . .	1,654,361	1,824,970	1,598,557	1,641,900	1,096,279	1,119,559
1899, . . .	1,605,090	1,729,202	1,439,183	1,431,856	1,088,051	977,827
1900, . . .	1,677,385	1,775,269	1,675,434	1,720,008	1,351,718	1,339,648
1901, . . .	1,647,177	1,758,573	1,868,078	1,948,234	1,054,252	1,068,554
1902, . . .	1,410,469	1,352,873	1,702,173	1,907,412	1,016,284	1,180,675
1903, . . .	1,406,529	1,338,888	1,561,898	1,889,140	932,576	1,047,295
1904, . . .	1,246,713	1,280,274	1,475,467	1,589,442	876,090	1,014,804
1905, . . .	1,224,960	1,249,698	1,791,902	1,966,343	809,107	1,017,512
1906, . . .	1,548,590	1,611,772	1,716,006	1,839,648	773,227	789,165
1907, . . .	1,419,732	1,496,211	1,965,873	2,152,668	934,797	799,632
1908, . . .	1,357,066	1,447,468	1,952,937	2,079,565	1,051,732	889,384
1909, . . .	1,102,479	1,102,226	2,017,854	2,168,816	905,596	868,937
1910, . . .	1,409,917	1,189,230	1,832,031	2,103,465	912,122	897,600

YEARS.	SAVANNAH.		GALVESTON.		ALL OTHER SEA-PORTS.	
	Entered.	Cleared.	Entered.	Cleared.	Entered.	Cleared.
1896, . . .	214,156	287,992	292,726	312,231	3,176,623	4,063,653
1897, . . .	283,389	343,392	580,652	566,200	3,885,897	4,280,215
1898, . . .	318,823	376,248	780,087	800,215	4,240,345	4,604,434
1899, . . .	318,310	349,769	859,160	928,981	4,355,969	4,887,727
1900, . . .	267,568	343,555	724,666	816,834	4,585,056	5,052,898
1901, . . .	334,258	377,929	646,126	742,008	5,061,750	5,606,017
1902, . . .	224,481	352,171	636,932	750,612	5,050,509	5,324,291
1903, . . .	192,538	390,179	603,530	885,786	4,741,968	5,163,925
1904, . . .	183,427	308,661	801,060	965,673	4,803,654	5,300,939
1905, . . .	170,536	432,533	884,536	1,081,248	4,794,981	5,086,935
1906, . . .	196,139	428,455	1,090,683	1,284,109	5,289,347	5,478,010
1907, . . .	208,547	456,273	1,333,084	1,597,043	5,443,900	5,836,400
1908, . . .	244,460	468,591	913,325	1,037,708	6,263,760	6,669,482
1909, . . .	221,494	448,390	1,094,400	1,339,337	6,129,492	6,555,185
1910, . . .	289,982	385,346	675,963	907,867	6,160,359	7,332,905



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